

### YEAR 4 ANNUAL REPORT OF THE NATIONAL SOCIO-ENVIRONMENTAL SYNTHESIS CENTER

Reporting on Activities from September 2014 to August 2015

www.SESYNC.org





### 1. Center Foundations – an Overview

Environmental problems are by definition social problems and so it follows that SESYNC was founded on the premise that progress toward a sustainable future requires new knowledge that arises from close collaborations across many disciplines and sectors including, for example, the natural and social sciences, the humanities, NGOs, and agencies. Further, this knowledge must be actionable.



SESYNC mission: foster synthetic, actionable scholarship on the structure, functioning, and sustainability of socio-environmental systems

SESYNC faces unique challenges. Socio-environmental (S-E) research problems are highly complex, typically have multiple solutions, and are often socially charged making them extremely difficult to study. So while all NSF synthesis centers are charged with the challenge of supporting scholars in using the synthesis method to generate new knowledge, SESYNC has additional and quite unique challenges. First, there is no clearly defined community of scholars, making communication and team building extremely difficult. Second, the level of interdisciplinarity required is unparalleled for an NSF center and brings with it a host of epistemological, methodological, and logistical problems. Center processes to foster integrative interdisciplinary research during very short periods of time typical of synthesis team meetings do not exist. Third, the theory, practice, and instruction of S-E synthesis is an undeveloped field. Fourth, unlike many actionable organizations that implement or promote policies or practices based on knowledge, our goal as an NSF center is to produce *fundamental* actionable knowledge. Such knowledge is not point-in-time, placed-based problem solving but knowledge that may apply in multiple contexts or may enhance our basic understanding of socio-environmental systems. Finally, the type of information that must be integrated to address S-E problems is extremely heterogeneous and often suffers from disparities in scale and resolution.

**The center as experiment.** The enormity of these challenges led us to design SESYNC as an experimental center. Our philosophies and practices are focused on addressing these challenges – trying out novel approaches and "listening" carefully to those we serve and what we see resulting. We have experimented with the design of programs and the implementation of processes to accelerate knowledge generation, build new communities, educate and engage young scholars and teachers, lower the barriers to adopting unfamiliar synthesis methods, and to grow the synthesis process. We place a premium on flexibility and openness to new ideas from the community -- not only topically but methods of engagement and synthesis team building. We practice "gentle interventions" with teams to help them overcome hurdles.

The challenges and the experimental and adaptive nature of SESYNC requires that the leadership and staff be very engaged with research teams. In only four years we have grown enormously and strived to become increasingly creative in our center processes and programs.

### Management Philosophy, Finances, and Staffing

The leadership and staff of SESYNC foster synthesis discovery and capacity building through the Center's disposition, processes, and programs. We work to seamlessly integrate our mechanisms for supporting research with the provision of participant support (group and one-on-one) such that project teams are empowered to move forward as quickly and creatively as possible.

The philosophy is to be highly reflexive and adaptive using an experimental approach we categorize into four phases.

- Early engagement
- Priming teams
- Customized team support
- Leveraging results

SESYNC is a service organization that implements programs and processes to accelerate scholarly production and learning using the synthesis method. We prioritize flexibility and seek new ways to support SESYNC-funded individuals or synthesis teams. This requires interacting with them early in their research process and, as needed or requested, interacting repeatedly throughout their project. We strive to make the Center a place the community wants to come – vigorous and intellectually stimulating but also a respite from the complex demands that our participants experience at their home institution or organization.

Funding from NSF is distributed among the various programs used to engage participants, the cyberinfrastructure, and some of the staff salaries. Drs. Palmer, Kramer, and Hawthorne's salaries are covered by the University of Maryland. Dr. Boyd's salary (50% support) is through a subaward to Resources for the Future. All synthesis team projects that originate from UM faculty, all GRAs, and all undergraduate interns are supported by UM funds. The facility lease is covered by the University of Maryland Center for Environmental Science (ca. \$450k/year). SESYNC has 17 full time staff and 2 part time who work as a cohesive and highly interactive unit and the leadership is non-hierarchical in practice. Creativity and individual growth is strongly encouraged for all employees.

### **Mechanisms for Engaging Participants**

SESYNC has a variety of funding mechanisms. We often call them our "programs" and all of them contribute to our research, education, and cyberinfrastructure goals and mission (Appendix 1).

Program	Description	Data at year 4
Pursuit (thematic)	Projects within rotating Themes co-developed by a community of scholars, and potential knowledge users through a facilitated process.	11 RFPs, 35 Pursuits 500 Participants
Ventures	Projects of high importance but not necessarily related to a Theme. High-risk or time-sensitive synthesis projects encouraged.	18 Ventures 350 Participants
Workshops	Single meetings focused on development of a new topic, under- developed field or promising idea.	29 Workshops 600 Participants
Foundations	Recruited projects on critical, emerging or understudied topics, or efforts that bring new disciplinary perspectives to S-E scholarship.	8 Foundations 100 Participants
Short Courses	By Leadership or Fellows: Teaching S-E synthesis; Bayesian Approaches; Database Management; Introduction to and Use of Cyber Tools.	7 Courses 200 Participants
Fellowships	Postdoctoral Fellows, Research Fellows, Sabbatical Fellows, Short-term Fellows, Journalism Fellows.	17 Postdocs 14 Fellows
Student Support	Graduate or Undergraduate students engaged through funded team projects, Assistantships or Internships	6 Grad Pursuits, 8 GRAs, 60 U-grads 100 Participants

### Part 2. Progress in Synthesis Science & Research Innovations

Progress can be conveyed in many ways. Certainly numbers tell part of the story, but capturing things like community building and creative outcomes are often best represented through qualitative information. For example, Wei-Ning Xiang (East China Normal University) and Joan Nassauer (Univ Michigan) led an interesting Pursuit project focused on urban sustainability in China. This project has been very productive as evidenced by the numbers: already 13 publications linking urban ecology to landscape planning, governance, public health, and environmental justice. Contrast this with a project co-led by Brendan Fisher (World Wildlife Fund) and Taylor Rickets (University of Vermont) focused on the link between conservation actions and human health. With no publications yet, it looks far less productive especially given that it was funded at about the same time as the Xiang/Nassauer project. However, it is clear this project is destined to have a high impact – not only have novel collaborations been built, but the resulting database will generate many more research projects. See the narrative sent to us by a team member (see Box: Case Study: "...it was bit harder than envisioned...").

### Case Study: "...it was a bit harder than we envisioned ... "

"It turns out that what we were trying to do was a bit harder than envisioned -- building a database with raw data from surveys of over 50 countries with over a million households and many million observations. But at every step SESYNC has had either a solution or the right steps towards a working alternative. Our effort is still on-going, but more than ever [we are] convinced of the usefulness of the end product **(the largest database linking human health and welfare with biophysical environmental data).** One of our findings that came as a side result for work we were trying to do was that we produced a map across 47 developing countries showing the inequality in land ownership and household wealth between maleheaded and female-headed households. We show that male-headed households have on average 12% more asset wealth and over 300% more land wealth, when compared to female-headed households. However, there are a number of regions in which female headed households have greater wealth. -- This paper is in review at Nature. Again this paper was not planned, but shows the kind of easy big-picture questions you can ask when you have a database as the one we are building at SESYNC."



### Progress by the Numbers and by the Stories

The total number of funded participants has roughly doubled each year and SESYNC is on a path to have more than 1000 participants visit the Center during this 4<sup>th</sup> year. The number of proposals we receive has risen steadily. This year we had approximately 60 applications for postdoctoral fellowships beginning next fall and 40 proposals for team synthesis projects for our most recently announced Pursuit Theme. The community is growing and is diverse by all measures – geographic, disciplinarily, by sector, gender, and race/ethnicity.

**Disciplinary/Sector Diversity**. The SESYNC leadership has invested a significant amount of time in assisting teams in identifying the disciplinary breath and specific people that are needed to address their research questions. This has contributed to creative productivity of new forms for most academic researchers. Sector diversity is substantial since many groups had participants from the potential "knowledge-user" community to help ensure actionability and scholars came not only from academia but from NGOs, governmental entities, and the business sector. Among the scholars and practitioners, disciplinary diversity within and among teams is clearly very high as shown below in the figure but it is worth noting that when participants are asked to self-characterize according to the types of disciplinary areas that NSF uses, there are lots of complaints! Many of our participants feel that they cut across several disciplinary lines, a trend which is increasingly common throughout science.



**Geographic Diversity.** SESYNC has been very successful at attracting international participants as well as engaging scholars from almost every state in the U.S. (48 states thus far – we still lack participants from Mississippi and North Dakota; from Nevada we have had 1 participant).





**Gender and Racial Diversity**. We are very pleased with the participant pool with respect to gender diversity and we continue to work on diversifying by race/ethnicity (Table 2.1). Of the participants that were willing to self-report the information, 18.4% are from groups traditionally underrepresented in the sciences (Asian or Pacific Islander, Black, Hispanic, Native American). Because our participants are from so many disciplines, there is not true point of comparison but to provide some context, we provide data on U.S. doctoral degrees awarded in the Biological Sciences from the NSB Science and Engineering Indicators (2014). Appendix 1 provides more details.

	Table. 2.1	RACE					
	White	Asian or Pacific Islander	Black	Hispanic	Amer. Indian or Alaskan native	Other or Unknown	No response
SESYNC participants	71.4%	9.8%	3.2%	5.1%	0.3%	1.1%	9.1%
All U.S. Bio PhDs	67.6%	11.7%	4.7%	5.8%	0.6%	9.6%	n/a

**Building New Communities and Novel Scholarship.** SESYNC leadership encourages new collaborations by match-making and gently nudging project PIs to include people they do not know who have appropriate expertise. While it is difficult to gather quantitative data on this, based on a partial analysis of funded projects (n=20), 53% of team members on average had not collaborated with their team leaders prior to working together at SESYNC. The use of new methodological approaches and/or integrating methods in

Case Study: "...the challenge was to incorporate qualitative social data into quantitative models."

"...we struggled with questions like what does it mean to have a social regime shift? Natural scientists had to learn from social scientists. .... We had to deal with scale mismatches between the ecological and social. We were trying to integrate in depth case study analysis with models and large scale meta-analyses. How do you do this? Not a single framework existed among the members." creative ways to produce results is also an indication of community building and progress. A team led by Chris Kueffer and David Richardson brought individuals from Australia, Germany, Portugal, Spain, and Switzerland with expertise in ecology, mathematics, modeling, geography, and political ecology. They are synthesizing knowledge on the social and environmental trade-offs and synergies associated with invasive species spread. They envisioned "anticipatory governance" guidance products based on what they learned from integrating data, modelling, and case studies. During a check-in meeting we learned that the primary challenge was epistemological (see Box:

Case Study: "...the challenge was to incorporate qualitative social data into quantitative models").

**Producing Scholarly Products.** Levels of productivity in the form of scholarly products are surprisingly high (Table 2.2) given that the first meetings of our oldest working groups were just about 2.5 years ago; most of our working groups are < 2 years old (see Box: "Scholarly Productivity to Date"). The papers that have been accepted or are in press include some of the highest quality journals that span many disciplines including: *Science, Nature Climate Change, Social Networks, Behavioral and Brain Research, Conservation Letters,* 

Table 2.2 Scholarly Productivity to Date			
Journal articles			
in press or accepted	105		
submitted/in review	30		
Books/Book chapters	13		
White papers	9		
Presentations	228		
Follow-on awards submitted	58		
Students supported	105		

*Current Anthropology, Ecological Economics, Ecology,* and *Landscape and Urban Planning.* Almost all of the articles are multi-authored and many have students and postdocs as co-authors.

Several of the articles and many presentations arose from teams dominated by disciplines that have been particularly difficult to engage – either because they don't apply to SESYNC, don't respond to our outreach, or find it difficult to work in the S-E synthesis mode for scholarly or sector sub-cultural reasons. Engineers and computer scientists are two examples of groups for which we have less participation to date than we'd like. Yet, there are signs that SESYNC's efforts may eventually bring more in. Leads from the engineerdominated Pursuit project "Modeling the coevolutionary dynamics of coupled human, water and ecological systems" provided an interesting quote (See Case Study: Box "...as a result of SESYNC funding...").

### Case Study: "...as a result of SESYNC funding...."

"... socio-hydrology [has] gained acceptance in the community, as indicated by the invitation to contribute to Socio-hydrology Debates in [a core water journal] and an invitation to convene special session at IUGG and AGU ..."

Case Study: "Our collaboration has forced team members to develop innovative ways to link disparate, but overlapping systems (social and natural, terrestrial and marine, micro and macro-scales)"

Working at the interface of anthropology, ecology, and economics the team is synthesizing extensive economic data (from household surveys and the government) with social data (ethnographic surveys) and ecological data from a region in Atlantic Nicaragua that is experiencing rapid change due to globalization pressure. The local people who once depended extensively on fisheries are now faced with dramatic declines in those resources and turning inward to terrestrial resources. However, the region's first transnational road was completed in 2007 and is leading to major changes. New fishing gear is being brought in, the population is growing, and there is an influx of new goods and technologies. The group seeks to understand the reciprocal impacts of those changes on biodiversity both inland and coastal as well as livelihoods and other social factors.

Results from some of the SESYNC funded synthesis projects have attracted a great deal of interest by the scholarly community and/or the broader sustainability community. We provide a few stories illustrating the depth of scholarship and new findings that have come from funded scholars.

Work led by Seeta Sistla (postdoctoral fellow, NOAA – UC-Irvine) and Daniel Kramer (Assoc Prof. Michigan State University) is focused on identifying the social and ecological mechanisms in which change in one region affects another region – "spills-overs" (see the Box: Case Study: "Our collaboration has forced team members to develop innovative ways..."). As a second example, postdoctoral scholar Lorien Jasny working with one of her collaborating mentors, Dana Fisher (both quantitative sociologists), have work to appear shortly in *Nature Climate Change* empirically demonstrating how opinions on science-relevant issues can be reinforced ("echoed back to them") by people who already have the same opinion. When this happens in a closed network ("chamber') people tend to believe the opinion is true, effectively blinding them to competing views. This can create significant barriers to critical discourse and has the potential to influence positive environmental outcomes (see Box: Case Study: "...echo chambers amplify divergence from consensus positions...").

### Case Study: "...echo chambers amplify divergence from consensus positions..."

While we might expect high levels of transitivity to be beneficial in some social relationships, like friendship and cooperation, these structures have a very different impact in networks of information transmission. For communication networks, the repeated nature of the ties may give members the impression that an issue is decided when there continues to be debate. What's more, when discussing science and policy, these findings are potentially very troubling. In the case of climate change, echo chambers may also amplify divergence from the consensus position. In other words, a few dissenting voices can be echoed and amplified so heavily through the chamber that they appear to represent a substantial number of dissenters.



Jasny & Fisher Fig. 2.1 Ego Networks Colored by Agreement with Strong Binding International Agreement (SBIA)

#### **Innovations at Multiple Levels**

SESYNC's commitment to be engaged with participants and their synthesis projects as well as our commitment to be experimental, reflexive, and adaptive has resulted in innovations well beyond individual projects. Sometimes our innovations are an adaptation of an existing program to improve it and sometimes they are new programs, processes, or activities that we perceive will benefit the community based on our observations and experiences as we move forward. We provide several examples (see also Appendix 3).

We incorporated new practices during the review process for proposals to reflect the community need to build capacity in how to: design projects that engage both social and natural scientists in ways that are exciting to each discipline, build a sufficiently diverse team, and develop specific questions and identify methods that increase the actionability potential. This required working with the Scientific Review Committee (see Box below) to change the review process from a strictly reject/fund mentality to a "Is there a creative and promising synthesis project here? If so, how can we provide input to improve it?"

### Scientific Review Committee

The SRC is designed as a venue specifically for interdisciplinary review. It is composed of 27 members spanning a wide range of disciplines (economics, ecology, planning, policy, biology, sociology, computational sciences, geography) who agree to serve for a minimum of 2 years to gain familiarity with SESYNC and our process. Facilitated meetings of the SRC include extensive discussions focused on improving proposals. Additional disciplinary expertise is added as needed for specific proposals by soliciting mail reviews or in special cases (e.g., education) through separate panels. As a second example of innovation, we have recognized the emergence of themes in our funded project portfolio that we did not initiate through an RFP process (e.g., a focus on *governance* has emerged). We then developed processes for introducing teams that share similar interests or methods and may benefit from collaboration; the introductions spanned multiple themes and Ventures. One of the ways we can keep abreast of what directions teams are going and/or how we might link them to others is through our "Check-in" meetings – something we added at the end of our second year.

A third example of an innovation is the *Foundations* program. It was not in our original proposal but it became obvious to us within the first year that we

were going to have to be proactive in bringing some disciplines and some topics to the table if we truly wanted to see the types of new communities form that are needed to solve difficult socio-environmental problems. With this new program, we began accomplishing this. For example, we recruited an

environmental philosopher/ethicist to lead a Foundations project and spent a great deal of time working to help this person understand the synthesis process and build a team to synthesize knowledge on the implications of the current shift from restoration of ecosystems to restoration of ecosystem services. The resulting team included individuals representing philosophy, legal theory, economics, ecology, conservation science, and political ecology. Progress by this group was accelerated by assisting in multiple phases of the project design and



by direct facilitation by a SESYNC leader during team meetings. With the PIs great input, this team was highly productive and new collaborations formed.

### 3. Strengthening Synthesis and the Effectiveness of Research Teams

Interdisciplinary teams are central to the success of synthesis research at SESYNC and we have developed a flexible process to support and accelerate teams throughout a project's lifetime. Given the unique challenges of actionable S-E scholarship, SESYNC's approach (our "process") has been informed by research in diverse areas including: inter- and transdisciplinary studies, cognitive and learning studies, and the science of team science. We interact with teams across four general phases -- engaging, priming, supporting, and outcomes. Feedback derived from formal and informal interactions, observations, and gentle interventions are essential throughout this process.

**Engaging.** SESYNC encourages early engagement with scholars as they develop their synthesis ideas. Roughly 50% of proposals submitted to SESYNC are initiated in this manner. Discussions focus on the suitability, novelty, and fundamental scientific contributions as well as data, team composition, and ways to effectively engage with "knowledge users". Projects are selected during a review process that is rigorous but designed to be helpful to PIs. Extensive written comments are provided — the majority of applicants are asked to work iteratively with SESYNC to strengthen their project design prior to receiving support. ~44% of applications have received support to date.

**Priming.** All projects begin with a video "priming call" where team leaders discuss their research plans with several SESYNC staff. These calls are an early opportunity to match services provided by the Center (e.g., computational and collaboration platforms and team science support) to project needs. They are an important opportunity to discuss how project design can be tailored to meet the challenges of interdisciplinary teamwork as well as to discuss avenues for developing actionable outcomes. Leads from all teams in a given Theme also participate in a short networking workshop where they present their research focus, project management approaches, data, methods, and teams to the others in the portfolio. In principle, groups can share data, methodological insights, and identify collaborators including participating knowledge users.

### A tool for priming

A short planning meeting for team leads is an option that SESYNC makes available to team leads. For a team studying ocean acidification, this brief on-site meeting facilitated by SESYNC led to an improved agenda and project design and opened discussions leading to the development and deployment of a variety of computational resources needed for the project. The work was completed in 2015 and resulted in both a publication in *Nature Climate Change* and a Congressional briefing.

**Supporting.** SESYNC works to meet the unique needs that emerge for each team — this can range from basic support to very extensive interactions. Computational support (*detailed elsewhere*) is often critical. At present SESYNC works with about 30% of teams to provide help in designing focused agendas, advice on approaches to interdisciplinary teamwork and direct facilitation of meetings — often focused on the development of shared conceptual frameworks or boundary objects. The underlying approach for these efforts is to help participants strengthen their capacity to work more effectively in an inter- or transdisciplinary setting. Participants are encouraged to interact with SESYNC leadership and staff at any point during their project's lifespan. SESYNC makes a concerted effort to gather information in formal and informal ways and as needed to gently intervene with suggestions to accelerate progress. In most cases,

these interventions have a positive impact although we recognize that some teams will want or need SESYNC simply as a platform to do their work and consequently will decline any support of this kind.

**Project Outcomes.** Our support for exceptional scholarship becomes evident in the publications and other products teams develop. However, we also place high priority on building and sustaining a set of capacities at the individual and team levels, including a better understanding of new disciplines, new technical skills, and a strengthened disposition to work collaboratively on problem-focused S-E synthesis research. We work to leverage these results by providing new opportunities that build upon cross team engagement including targeted meetings, planning workshops, and new projects that bring together expertise and findings from prior team efforts in new ways.

### Case Studies: The role of facilitation

SESYNC plays a substantial role in accelerating the team synthesis process. In both cases we deployed a similar mechanism, however, the role and impact varied. In the first case, facilitation provided a catalyst to overcome a critical barrier. In the second case, facilitation was useful, but the conceptual breakthrough was achieved in large part because the session itself provided an interdisciplinary venue to explore alternate approaches. To be effective, facilitation must be tailored to each group and must be flexible enough to accommodate changing circumstances. In many respects, success is evident when teams gain confidence in and full ownership of their process and the facilitator quietly steps away.

**Case 1:** A team of ecologists and business scholars examining how biodiversity measures could be utilized in corporate sustainability planning reached a stumbling block. After a loud and contentious session, the facilitator and team leads led sub-groups in an exercise to develop conceptual frameworks for the project. The facilitator asked a biologist and corporate sustainability specialist to re-examine their respective frameworks — both laden with context and discipline-specific language — by looking for specific entry points where information might flow from one to the other. That broke down a fundamental barrier — *the key was how information could be utilized, not the specifics of that information* — and provided the path forward for discussion and ultimately consensus on a shared framework for the entire team.



**Case 2:** A team of engineers, social scientists and biologists examining socio-hydrological systems using models of varying scales (from small toy models to large scale system models) needed to develop a way to link their approaches in a common framework. Extensive work with SESYNC leadership prior to the meeting led to an agenda that included a frameworks session. When sub-teams presented their frameworks, they could not see how they could be linked. The facilitated discussion stalled until a team member with a background in governance suggested that, rather than developing an entirely new framework, the team consider looking at the project through a governance-focused lens. He provided the team with information on an Ostrom framework — his specialty. *This became the catalyst that allowed the team to move ahead and contextualize their work in a useful way*. Ultimately, facilitation was about simply moderating the session so the team could feel confident that they could move ahead.

### Part 4. Actionable, Socio-Environmental Research

Actionable scholarship is research with the potential to inform decisions within government, business, and households; improve the design or implementation of public policies; influence public or private sector strategies; and inform planning and behaviors that affect the environment. Actionable scholarship lies between "basic" research (research that lacks obvious, immediate application) and "applied" research (research that is too parochial, targeted, or narrow to advance NSF's goal of advancing fundamental knowledge<sup>1</sup>). It tends to be solutions-oriented, rather than purely descriptive. And it requires input – during all phases of the research process – from audiences outside academia. SESYNC takes a deliberate approach to fostering actionable research.

Actionable research requires new knowledge and partnerships and often alters researchers' hypotheses, methods, and data. It is also often under-rewarded within academia. SESYNC therefore takes a deliberate approach to fostering actionable research. We do this in both systemic and targeted ways.

### Case study: Global-scale actionable research

SESYNC supported the creation of a global database that links urban populations to their dependence on freshwater ecosystem services. The project allows governments, communities, and NGOs to evaluate the vulnerability of urban water supplies to changes in watershed land cover, climate, and other environmental factors. The database links biophysical data and social data across 60,000 village clusters from around the developing world in a way that allows decision-makers to visualize and map urban dependence on upstream water.

*Systemic strategies to promote actionable scholarship.* A core strategy is the inclusion of "knowledge users" in the SESYNC community and on research teams. Knowledge users refer to practitioners in a position to make decisions, set policy, or communicate S-E science outside academia. Their key feature is that they reside in institutions (government, business, NGO) with missions beyond pure academic inquiry.

Our proposal evaluation criteria include encouragement of (1) inclusion of knowledge users from institutions beyond academia and (2) a solutions orientation and potential to contribute to actionable science. Often SESYNC leaders work iteratively with potential PIs on these elements prior to proposal submission. Knowledge users are meant to be active participants in the research, not passive audiences for it. As participants, knowledge users not only can affect the questions addressed, but also are more likely to be engaged in the diffusion and communication of research findings. To date, more than 200 of our participants come from outside academia.



Actionability also affects our approach to team facilitation (where relevance to policy, institutional, and resource management is deliberately introduced and integrated into conceptual models; motivates our

<sup>&</sup>lt;sup>1</sup> SESYNC's charge is not to focus on solutions to specific, place-based problems, nor implementation of specific institutions' programs, but rather to advance insights applicable to broad, even global, environmental issues. And SESYNC does not and cannot advocate for specific policy changes.

emphasis on geospatial data and informatics (due to spatial information's increasing importance to decision making and science communication) and was a rationale for our "Theme PI meetings" (designed in part to foster knowledge user collaborations across research groups). We provide policy education to our graduate student and postdoc participants via seminars on institutions, laws and regulations, and natural resource management applications.

## Case study: science to inform new regulatory approaches

SESYNC has supported a group of government regulators, academic researchers, and business representatives to characterize globalization of the live plant trade and identify strategies to reduce non-native pest invasions. The work has generated new insight on how plant imports serve as pathways for plant pest invasions and identified ways in which regulatory policy could minimize the ecological and economic costs of those invasions.

### Targeted projects to promote actionable

**scholarship.** SESYNC leadership has initiated a set of targeted projects focused on policy and actionability questions pertinent to S-E research. These include:

- Development of "Foundations" projects focused on topics including: "Large-Scale Natural Resource Conservation and Restoration," "Sociological Perspectives on Non-State Actors in Environmental Governance," and "The Limits of Environmental Governance"
- A set of ongoing activities related to providing research-based input to inform development of guidance on ecosystem services analysis for federal agencies.



Case Study: Socio-environmental research and government decision-making

With a grant from the Packard Foundation, SESYNC is conducting research on the use of S-E research in federal decision-making. The objective of the research is to identify management and administrative factors that affect the ways in which decision-relevant S-E science is identified and applied by federal agencies. Our research team has interviewed more than 40 federal managers and scientists and through a series of workshops is engaging dozens of additional federal practitioners. The project is in part public administration research – can science and decision interactions be improved? And, in part, feedback to the S-E research community on how to make their work more actionable.

### Part 5. Building Capacity and Community for Synthesis Research: Education and Professional Development

The primary focus of SESYNC's education agenda is to build capacity for socio-environmental synthesis (SES) research and practice. We seek to identify the knowledge, skills, and dispositions necessary to excel at SES both as individuals and as members of interdisciplinary teams and to develop methods for improving SES performance through education. We approach these goals by offering programmatic opportunities at various levels, targeting research on synthesis learning, the development of an SES research community through professional development opportunities to practice SES, and the development of instructional resources to increase the exposure of students to SES concepts and practice.

**Professional Development.** The postdoctoral fellows are essential to our education program, through which we provide opportunities for young scholars to be immersed in the daily environment of SES while moving ahead on their own challenging research agendas. We provide a structured professional development program for our postdocs using workshops, short courses, invited speakers, travel support, a mentorship program, and annual reviews and presentations to the SESYNC community to build their skills and knowledge in key topics. We also provide a rich environment for developing the disposition of socio-environmental synthesis researchers through an array of opportunities including weekly seminars, regular postdoc discussions, daily interactions with senior SESYNC leadership and visiting researchers, and interactions with computational staff to facilitate their research (See "SESYNC Postdoctoral Mentoring Program", Appendix 4). Additional professional development opportunities include a summer internship program for undergraduates, graduate student workshops, and a Pursuits program (6 Pursuit teams funded), sabbatical fellowships, a mentors program associated with the postdocs and the undergraduates, and a short course for college instructors.

*Instructional Resources.* We have provided a series of workshops and short courses designed to offer instruction in specific skills to both SES researchers and college instructors. Additional instructional resources are developed in some of the short courses that can be used in college-level classrooms. We provide those resources to instructors everywhere with additional resources, including tutorials on SES and classroom activates on our web page.



**Research on SES Education.** To build theory and instructional fundamentals in socio-environmental synthesis, we support Pursuit team research on: 1) integration of information across disciplines for actionable outcomes and 2) practices and theories for team research (proposals now under review). We also support two Ventures each developing classroom or campus-wide strategies for using SES to improve educational outcomes in STEM classrooms.

*Links across the Center.* All of the programmatic elements mentioned above share features across categories, some of

the research Pursuits involve development of professional development curricula or instructional resources, and some of the instructional resources efforts have professional development outcomes. Similarly, education efforts at SESYNC are linked to research and cyber efforts at the Center. For example, several of our short courses (Software Carpentry, Bayesian Analysis, and Visualization of Data) have been inspired and produced by our cyber-team to boost specific analysis and computational skills of our research community, and several of our postdocs have strengthened their teaching portfolio through participation in

the Case Studies Short Course or development of a graduate level course introducing the basics of Socio-Environmental Synthesis.

#### Innovations in Professional Development: Postdoctoral Fellows

**Postdoctoral Fellows Immersion Program:** SEYNC has developed an "Immersion Program" designed to foster further growth of postdocs disciplinary strengths applied to S-E research and to prepare them to thrive in this cross-disciplinary research and scholarship domain. The Immersion Program involves 1) selection of postdocs who's proposed synthesis research may bridge social and environmental science OR remains grounded in their discipline (e.g., Ecology, Geography, or Economics) but all have a desire to enhance their abilities to undertake interdisciplinary research, and 2) hosting a series of workshops led by influential scholars synthesizing the conceptual and theoretical contributions of several key disciplines to S-E research (Ecology, Anthropology, Sociology, Economics—See Appendix 4 for schedule and agenda). Through increased and *intentional* consideration of the diverse disciplinary foundations of S-E synthesis science and their interactions, we intend that our postdoctoral fellows will become effective and impactful disciplinary "bridgers." Recruitment of this cohort is underway and the workshops will be available to all postdocs and staff scientists in residence in 2015-2017.



### Innovations in Graduate Student Training

SESYNC welcomes emerging scholars and thus has made a special effort to support interdisciplinary teambased research by advanced graduate students. In 2012, students were engaged in a workshop that introduced S-E synthesis and development of research themes. Two priorities emerged, Urban S-E Systems and Surprise in S-E Systems. Building from this effort, we offered a capacity building workshop in 2013 focused on aspects of S-E systems, proposal writing, and leading and/or participating in interdisciplinary teams. The program culminated with a 2014 thematic RFP directed specifically to graduate students. Six of fourteen proposals were approved and are currently underway. Several teams are led by students who participated in the capacity building workshop. Recognizing the unique aspects of graduate student research, teams are limited in size (6-10) and duration (12 months). Each team receives the same portfolio of support services offered to all researchers at SESYNC. All participate in a processmentoring program led by SESYNC staff. This includes planned pre- and post-meeting briefings as well as "check-ins" during the course of their meetings. Synthesis efforts were initiated and will end with a joint meeting of team leads providing an opportunity for shared learning about the experience. Initial response from the students (see Appendix 5) has been overwhelmingly positive. We anticipate initiating another cohort in 2015. **Outreach.** We take a strategic approach to outreach, combining regular communications through web and social media venues with highlights of recent research outcomes and opportunities (implemented by Melissa Andreychek). Science journalist Lisa Palmer was our first science communication fellow, writing pieces on research teams and on land-use and climate challenges for *Nature Climate Change*, the *Guardian*, and blog posts for our web page and others.

### Part 6. Computational and Cyberinfrastructure Support

SESYNC cyberinfrastructure (CI) supports a broad range of activities for a large community of participants and on-site scholars. Through an array of integrated services, SESYNC CI enables researchers to collaborate; to address research problems at unprecedented scales; and to build their own capacity to do computationally-enabled, socio-environmental analysis.

**Early Engagement.** Recognizing that supported teams and fellows have a range of needs and expertise, we work individually with each project before their first on-site meeting to assess needs and capacity and to develop recommendations for resources. Often a project's requirements will change as it evolves, so we encourage regular communication between SESYNC CI staff and supported researchers to ensure we adapt resources as needed.

**Computing Resources.** The suite of hardware and software we offer is designed to provide maximum computing power with minimal barriers to entry. Large data storage and database servers can be accessed by group members via SSH, a web file gateway, virtual desktop, or SESYNC's RStudio Server. All services SESYNC offers have been tightly integrated so that researchers have seamless access to all of their group's data resources regardless of which SESYNC service they are using. In the latter half 2014, we deployed a scheduled cluster to support large analyses requiring multiple nodes. This cluster has already been used by several groups and postdocs since its introduction (Appendix 6).

*In-House Expertise.* SESYNC's CI staff provides technical consulting to accelerate progress on projects with unmet needs. The breadth of technical support is illustrated by these examples:

- Designing database schema for integrating ecological, management, and spatial data sets on marine protected areas;
- Providing stub code to connect R to a custom database of 52 million household survey records;
- Assisting with geospatial integration of 8 million census blocks and 1 billion toxic release data points;
- Integrating economic, land use, harvest, and species data to assist in valuation of ecosystem services from trees;
- Providing one-on-one tutorials in SQL, ArcGIS, and parallelizing R code; and

Number and percentage of projects receiving Cl support					
	Hardware/ Software	Consulting/ Custom	Training		
Pursuits	15 (43%)	13 (37%)	5 (14%)		
Ventures	9 (50%)	4 (22%)	3 (17%)		
Postdocs	12 (80%)	11 (73%)	13 (87%)		

- Working with researchers to plan for the long term disposition of their data and code.

**Computational Training, Community Capacity Building, and Cross-Center Collaboration.** SESYNC regularly offers short courses to familiarize our community with tools like R, command line (shell), collaborative code development (git), SQL, and more. This instruction not only accelerates progress on SESYNC projects, but

also connects the Center's education mission to CI by preparing researchers for future work on computationally demanding socio-environmental problems.

### Quote from Computational Short-course participant

"...my team so deeply appreciates the highest level of technical support, novel planning and the overall leadership at the CSI [SESYNC Computational Summer Institute]. We are most humbled and learn[ed] a lot more than we anticipated. We could end up with a product that will help us share our outputs in ways we never imagined before. We are most thankful."

Other NSF bio-centers face this same challenge of building computational literacy and capacity. Over the past year, we have worked closely with four other centers (iDigBio, iPlant, BEACON, and NESCent) in the development of an education program called Data Carpentry (<u>http://datacarpentry.org/</u>) which follows the spirit of Software Carpentry (<u>http://software-carpentry.org</u>) model. This hands-on, two-day course aims to teach basic data management and manipulation skills to scientists, skills which are crucial to synthesizing the various data sets groups bring to SESYNC.

Data Carpentry was created in part through the support of an OCI supplemental grant in 2012 (known as "Collab-IT"). This grant has enabled SESYNC to lead monthly conference calls with other centers' IT staff and plan a yearly all-hands meeting where staff from a number of bio-centers meet to discuss common problems and explore new collaborations. Collab-IT has led to a greater understanding of the capacities of the different centers as well as a number of smaller collaborative endeavors such as coordinating conference attendance, cross advertising, and sharing assessment metrics.

### Case Study: Mary Collins, Postdoctoral Fellow

Mary Collins began her postdoc at SESYNC with the intention of scaling up work that centered on an analysis of environmental justice issues in Wisconsin. For her doctorate, she had focused only on Wisconsin because the computing resources and expertise for a larger analysis were unavailable. The combination of SESYNC's hardware and software, geospatial data processing and analysis expertise, and computational training for Mary enabled her to expand her analysis to the entire nation, and she is now working to add a time series component. Mary is using the CI support she received at SESYNC to engage a community of scholars who work on environmental justice issues through a workshop supported under SESYNC's new computational Theme.

	Pre-SESYNC	at SESYNC
Study area	Wisconsin	48 contiguous states
Number toxic releases analyzed	26 Million	over 1 billion
Time per analysis	30 minutes	5 minutes

**New Developments.** SESYNC's CI has been developed in response to ongoing assessment of community needs. As these needs change, we continue to adapt our programs and offerings as necessary. Two major programs highlight our leadership and continued support for computation to transform socioenvironmental analysis.

- A Computational Theme with ten new projects that will showcase how big data and model integration can inform major socio-environmental challenges.
- A new Data-to-Motivate-Synthesis (DTMS) program will provide a platform and venue for early scholars to explore data and formulate new questions on food-water-energy systems.

### Part 7. Strategic Planning and Evaluation

*Introduction.* SESYNC has adopted a utilization-focused<sup>2</sup> approach to strategic planning and evaluation. Ours is an integrated effort designed to help us define and refine goals, understand progress, and provide evidence to support adaptation. The approach is consistent with a management culture that views learning, flexibility, and creativity as essential for meeting our mission.

**Strategic planning.** The SESYNC 2011-2016 Strategic Plan has its foundation in a shared understanding of values and mission, and a vision for achieving specific goals and objectives. The plan was informed by input from internal and external stakeholders, and SESYNC's External Advisory Board who also approved it. In addition, focus groups composed of social and natural scientists, policymakers, and representatives from governmental agencies and non-governmental organizations provided input on potential research Themes. All of SESYNC's activities are tracked relative to the *Strategic Plan* — SESYNC uses that overarching document to guide and coordinate evaluation in its entirety. Accordingly, performance metrics and benchmarks were developed based on data collected during the first two years of center operations and were completed in early 2014 coincident with the mid-term revision of the Strategic Plan (Appendix 7).

**Evaluation.** SESYNC's focus on adaptive management has led us to implement a multi-level evaluation that incorporates both formative, summative, quantitative, and qualitative approaches. Data are collected by Dr. Ann Zimmerman, an external evaluator, and by SESYNC directly. The approach includes three foci for data collection: 1) demographics (from personal to discipline) and measures of basic scientific productivity (publications, presentations, students, etc.), 2) a formative/developmental external evaluation focused on the efficacy of SESYNC's programs and processes, and 3) informal surveys regarding opportunities and challenges of interdisciplinary teamwork. Full details of all evaluation efforts and results are found in Appendix 8.

### Participant Reflections

"It can be extremely difficult to overcome epistemological differences when working in interdisciplinary groups. I expected it to be difficult and it was. But I also feel great about how intentionally we worked on our misunderstandings". (Graduate student)

"We have greatly advanced in bridging between a natural sciences and a humanities qualitative social sciences understanding of human-nature relationships that will be crucial for further advancing our understanding of (cultural) ecosystem services and of impacts of invasive species on the social and cultural dimensions of socioecological systems" (Senior-level academic)

"As an ecosystem ecologist who works at relatively small scales in terrestrial systems, it has been very valuable to consider how to contextualize the types of data I traditionally use within the larger social, economic, and ecological contexts in they are embedded. In this sense, the unique opportunity to explore intra- and interdisciplinary thinking supported by SESYNC has resulted in novel uses of our data sets and spurred novel "conceptual models. (Junior-level academic)

**Evaluation Findings: Highlights of SESYNC's Accomplishments.** SESYNC brought together an exceptional disciplinary demographic of participants — achieving one of our fundamental goals. In addition, approximately 24% of participants were "knowledge users" from government, NGO, and business communities. Participants came from 48 U.S. states and 41 countries; 56% were men and 44% were women.

<sup>&</sup>lt;sup>2</sup> Patton, Michael Q. 2012 Essentials of Utilization-Focused Evaluation. Sage Publications Inc. 461 pages

Productivity by teams and individual researchers (e.g., Postdoctoral Fellows) has been strong with over 100 manuscripts published or in press across a much wider spectrum of journals than observed in other synthesis centers. Five-year impact factors range from 1-23 although a number of journals were new and are not yet rated in this manner (see Appendix 2).

Both informal survey data and results from the external evaluation show that SESYNC has become a viable platform for S-E research — 63% of survey respondents reporting high benefit from interdisciplinary interactions at the Center. Participants interviewed widely praised logistical support and facilities. SESYNC's efforts to bring new configurations of participants together were valued. When utilized, facilitation and team science support services were viewed positively — in particular, help in developing shared conceptualization of projects. Advanced computational support was very valuable for those who took advantage of the services.

*Putting Evaluation Findings to Work: Challenges Revealed and Adaptations Made.* Evaluation also uncovered several important findings that have led SESYNC to adapt its approach.

Interviews revealed that there is an uneven awareness of what SESYNC can offer by way of support, particularly among team members (vs. leaders) and some services are likely underutilized because of this. Computational support was important for teams, but a greater awareness of what can be provided would have helped some teams. We have responded by increasing the amount that we check in with teams to gauge needs and to make them aware of options including adding new participants and opportunities for computational support. Interviews also suggested that some teams utilizing facilitation wanted a more sustained interaction. Consequently, we have been working to provide more continuity to those who seek these services as well as making all teams more aware of them.

A key finding was that participants interviewed want more knowledge of SESYNC activities in general, and greater opportunities to interact with other teams. In response, we are making a much greater effort to create opportunities for sharing through joint check-in meetings and more direct follow up with teams by SESYNC Leadership. In addition, we are using the Theme structure to enhance coordination overall, but especially among education Pursuits. Finally, we have been enhancing our general communications/ outreach capacity to better convey both the breadth and specificity of work being done at the Center. Adaptations that have occurred in a number of other areas are summarized in Appendix 3.



**Questions for the Future.** Data from our assessment gives us confidence that we have created a viable and valuable platform for S-E synthesis research. It has also revealed key lessons for us to consider as we move forward. We frame these as questions that will inform how we adapt in the coming years:

- Should, and if so, how can we expand our focus on team leaders to entire teams and what products and programs will be needed to better leverage resources at the Center?
- How can we expand SESYNC'S direct facilitation efforts from its current level (20% of teams across all programs) to have a greater impact on more teams? What new approaches and staff capacity will be needed to create and sustain such interactions?
- How can SESYNC expand awareness of computational support and efficiently provide additional teams with support?
- Should SESYNC work to develop a broader capacity to reach more teams or should we develop a more targeted approach potentially designed to provide more services to teams with the greatest need or with identified potential to achieve highly novel and high impact outcomes?
- What additional approaches can we implement to link and leverage teams to advance S-E science and problem solving? What capacity and resources will be needed to make this viable?

Resources for the Future	Dr. Jim Boyd, our Director of Social Science and Policy is a
niip.//www.rjj.org/Puges/uejuun.uspx	forward on any incompany and and research institution
	focused on environmental and resource economics and its
	application to public policy; we draw on its network of
	scholars and partners in government, the NGO sector, and
	business community. RFF's VP for Research, Molly
	Macauley serves on SESYNC's EAB.
University of Maryland Center for	We share space with UMCES and they fund our lease;
Environmental Science	President Donald F. Boesch serves in an advisory capacity as
http://www.umces.edu	does faculty member Andrew Elmore.
Helmholtz Centre for Environmental	Dr. Karen Frank serves as a member of SESYNC's EAB and
Research (UfZ)	has facilitated a number of interactions with UfZ including a
http://www.ufz.de/index.php?en=11382	recent visit in Germany between Leadership of both
	institutions.
German Biodiversity Centre and	We have worked closely with sDiv to develop and co-fund a
Synthesis Center (iDIV, sDIV)	set of Pursuits addressing Biodiversity and Ecosystems
http://www.idiv-	Services. Six international teams are currently working
biodiversity.de/en/idiv/news	under this Theme. In addition, Dr. Volker Grimm from iDiv
	has been instrumental as an mentor for SESYNC
	Postdoctoral Fellow Neil Carter.
Gallaudet University	Drs. Caroline Soloman and Khadijat Rashid have partnered
http://www.gallaudet.edu	with us in the development and testing of instructional
	resources.
Cary Institute for Ecosystem Studies	Dr. Kathie Weathers is a Senior Advisor and Chair of our
http://www.carvinstitute.org	EAB. During first 2 years, we provided senior scientist Alan
······································	Berkowitz with a subaward to lead our Founding Education
	Theme, Currently, Senior Scientist Peter Groffman works
	with us/NSF on the LTER-SESYNC postdoctoral program.
University of Michigan	Dr. Joan Nassauer was one of the original members of
http://www.snre.umich.edu	SESYNC's leadership team and provided essential insights

### Part 8. Selected SESYNC Partners and Collaborators

	and linkages to the social science community in at Michigan and beyond.
Coppin State University	Dr. Mintesinot Jiru works with us in developing instructional
http://www.coppin.edu	resources and mentoring undergraduates in our internship
	program.
Washington State University –	Drs. Gretchen Rollwagen-Bollens and Paul Thiers work with
Vancouver	us in the development and testing of instructional
http://www.vancouver.wsu.edu	resources.
National Center for Ecological Synthesis	Coordination, shared learning and co-funding of synthesis
https://www.nceas.ucsb.edu/	projects have occurred with all these synthesis center
	partners.
National Evolutionary Synthesis Center	
http://www.nescent.org/	In addition all have partnered in outreach to the Ecological
	Society of America community of scholars.
National Institute for Mathematical and	
Biological Synthesis	
http://www.nimbios.org	
Department of Entomology	The Department provides salary and on-campus meeting
University of Maryland	and office space.
http://entomology.umd.edu	
US Department of Agriculture	Collaborators on the developing "Data to Motivate
	Synthesis" program. Both agencies will share data, provide
US Geological Survey	cyber support for select workshops and will advise on Food
	and Water Themes.
University of Nairobi	Developing partnership focused on bringing together
http://www.uonbi.ac.ke	researchers from several East African countries to study
	frameworks for sustainable natural resource management
	and to develop a distributed graduate course in Africa.
Harvard University	Developing collaboration focused on interdisciplinary STEM
http://www.pz.harvard.edu	understanding of global issues through the use of digital
	journalistic information.

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# Appendix 1.

Funded Projects and Participant Demographic Profile for Years 1 - 4 inclusive (up until time report was prepared)

### **Appendix 1. Funded Projects and Participant Demographic Profile**

### **EXECUTIVE SUMMARY**

This Appendix contains: 1. a list of all SESYNC supported projects since Year 1; 2. a portfolio of submitted versus funded projects and activities; and 3. a profile and demographic analysis of funded SESYNC participants.

**Section I** contains a list of projects and associated titles funded through the present (Years 1-4). SESYNC has supported a total of 74 Pursuits, Ventures, Workshops and Foundations, 16 postdoctoral fellows, and 11 sabbatical/visiting scholar fellows. In section I below, projects supported during Year 4 are marked with an asterisk. This section also describes the background and research for each Postdoctoral Fellow and Sabbatical Fellow/Visiting Scholar.

**Section II** shows the number of applications submitted and the number of proposals supported per program. Since its inception, SESYNC has received 254 applications for its core programs (Pursuits, Ventures, and Workshops) and funded 66 (44.3%) of these proposals, excluding SESYNC-initiated workshops and Theme 11 as it is currently under review SESYNC received 223 applications for its Postdoctoral Program (6 RfPs to date) and funded 15 fellows from those calls (6.7%).

**Section III** describes the number of participants funded through SESYNC and illustrates a demographic analysis of participants who filled out a survey. SESYNC has funded 1674 individual participants since its inception. Approximately 208 individuals have participated in more than one SESYNC program. Of SESYNC participants, approximately 917 unique individuals from our Pursuit, Workshop, Venture, Foundation, and Short Course programs filled out a survey.

### Demographic analysis summary:

- Of those who filled out a survey, there are 516 men and 401 women (56.3% and 43.7%, respectively). Approximately 77% of participants are from the United States and 33% of participants come from 41 countries around the world. Those from the US come from 48 states in addition to Washington, DC.
- Of those self-reporting their self-characterization from our Pursuit, Venture, Workshop, and Foundation programs, 34% are natural scientists, 22% are social scientists, 3% are computer scientists, 8% come from the NGO/government/policy/industry sectors, 17% are both natural and social scientists, 13% self-report as more than one or other, and there is a 3% no response rate.
- Participants are also categorized as "academics" or "knowledge users" based upon their selection for "institutional status" within the demographic survey. Academics are those within academic institutions as graduate/postdoc students and teaching or research faculty. Knowledge users are those within the policy, business/industry, government, or NGO/non-profit sectors. Of those reporting from our Pursuit, Venture, Workshop, and Foundation programs, there 592 academics and 198 knowledge users. Of the knowledge users, 51% come from the NGO/non-profit sector, 42% from the government sector, and 8% from the business/industry sector.

### I. List of projects funded through present (Years 1-4)

Projects supported during Year 4 are marked with an asterisk.

### A. Pursuits

## Theme 1. Ecological Wealth and Changing Human Populations (11 proposals received). The following were supported:

• 2012T1-003: Evaluating relationships among human health and welfare, ecological condition and natural resource governance (B. Fisher, T. Ricketts)

• 2012T1-005: Creating a global database of how different populations within cities are dependent on freshwater ecosystem services (R. McDonald, D. Balk)

• 2012T1-006: Rural forest communities at a tipping point? Trends and actionable research opportunities (B. McGill, K. Bell)

• 2012T1-009: Synthesis to link understanding, planning, and management of urban ecosystems in China (W. Xiang. J. Nassauer)

• 2012T1-011: Urban ecological sustainability: Multi-level governance of water, energy and carbon in the Northeast mega region of the United States (S. Pickett, J. Connolly)

Theme 2. Globalization and Environmental Change (9 proposals received). The following were supported:

• 2012T2-003: Globalization of the live plant trade: Informing efficient strategies for reducing non-native pest invasion risk (R. Epanchin-Niell, A. Liebhold)

• 2012T2-009: Globalizing Our Understanding of Rural Land Use Change. (J. van Vliet, E. Ellis) Proposal was resubmitted and funded for a single workshop.

## Theme 3. Informing Sustainability and Adaptation Decisions through Assessment and Modeling of Ecosystem Services (8 proposals received). The following were supported:

• 2012T3-003: How will businesses speak biodiversity? Novel and adaptive uses for ecosystem services data (S. Duncan, S. Elliott)

• 2012T3-004: Monitoring the direct links between ecosystems and people (H Tallis, B. Reyers, S. Andelman)

• 2012T3-005: Incorporating values and assessing social and environmental trade-offs in managing for ecosystem services (L. Olander, D. Urban)

• 2012T3-007: Solving the mystery of marine protected area (MPA) performance: Linking governance, conservation, ecosystem services, and human well-being (H. Fox, R. Pomeroy)

• 2012T3-008: Integrating biodiversity and ecosystem services into sustainable global climate mitigation scenarios (G. Hurtt, J. Edmonds)

## Theme 4. Globalization & Socio-Environmental Systems (5 proposals received). The following were supported:

• 2013T4-005: Linking local consumption to global environmental impacts (K. Hubacek and K. Feng) Proposal was resubmitted for and funded as a single workshop.

### Theme 5. Water, People, and Ecosystems (8 proposals received). The following were supported:

• 2013T5-001: Towards socio-hydrologic synthesis: modeling the co-evolutionary dynamics of coupled human, water and ecological systems (T. Troy and M. Sivapalan)

• 2013T5-007: Social-ecological system resilience, climate change and adaptive water governance (B. Cosens and L. Gunderson)

• 2013T5-008: Climate change and water resources adaptation: Decision scaling and integrated ecoengineering resilience (L. Poff and J. Matthews)

## Theme 6. Learning to Integrate across Natural and Social Sciences (10 proposals received). The following were supported:

• 2013T6-002: Understanding, teaching, and employing model-based reasoning (MBR) in socioenvironmental synthesis (EMBeRS) (D. Pennington and A. Danielson)

• 2013T6-007: Translational ecology: A pedagogical framework to integrate natural and social sciences (M. Brunson and M. Baker)

• 2013T6-009: The development of a social and ecological framework for understanding climate change mitigation and adaptation (R. Shwom and R. Jordan)

### Theme 7. Biodiversity and Ecosystem Services (28 proposals received). The following were supported:

• 2013T7-006: Anticipatory governance and societal feedbacks in socioenvironmental transitions: multicontinental acacia invasions as a model system (C. Kueffer and D. Richardson)

• 2013T7-011: Effects of land use on the trade-off between biodiversity and provisioning ecosystem services (R. Seppelt and S. Lavorel)

• 2013T7-012: Ecological and Social Linkages among Biodiversity, ESS, and Environmental Policy and Management in the World's Cities (M. Aronson and C. Nilon)

• 2013T7-013: Synthesis of micro-scale human decision making to mitigate risks to ecosystem services (M. Schluter and M. Janssen)

• 2013T7-015: Feedbacks between biodiversity and ecosystem functions and services during the recovery process of restored ecosystems after anthropogenic disturbance (D. Mateos and H. Jones)

• 2013T7-018: Playing dominoes with tipping points? Exploring the linkages between anthropogenicallydriven shifts in marine and terrestrial biodiversity and ecosystem services in a rapidly globalizing coastal region within the Mesoamerica Biodiversity Hotspot (S. Sistla and D. Kramer)

Theme 8. Data-Intensive Analysis & Modeling for Socio-Environmental Synthesis (22 proposals received). The following were supported:

• 2014T8-016: Pursuit for a modeling framework for addressing drought impacts in Kenya: Dynamic systems and adaptation policies (B. Agusdinata) Proposal was resubmitted for and funded as a single workshop.

• 2014T8-017: Hawaiian watershed hydrologic and ecosystem services response to predicted shifts in forest structure in a changing climate (T. Wong and J. Price)

• 2014T8-018: Development of a prototype of an integrated modeling system for socio-economic and environmental analysis to promote sustainability at the regional level (G. Knapp and R. Moeckel)

• 2014T8-020: Integrating ecological data into investigations of urban scaling effects (M. Alberti) Proposal was resubmitted for and funded as a single workshop.

#### Theme 9. Graduate Student Themes (14 proposals received). The following were supported:

• 2014T9-003: The Socio-Environmental Conditions of Cities that Enable Payments for Watershed Services (D. Bennett and J. Hoyle)\*

• 2014T9-005: Navigating the unforeseen: How governance can better account for and accommodate surprise in social-ecological systems (S. Alexander and J. Pittman)\*

• 2014T9-007: Drivers of and barriers to sustainable urban water management: Miami, Las Vegas, and Los Angeles (M. Garcia and A. Deslatte)\*

• 2014T9-010: Shifting fish and shifting fishers: Examining fishing communities' responses to range shifts of marine fish species (B. Dubik and T. Young)\*

• 2014T9-011: Understanding shifting human-fire dynamics in the San Diego-Cleveland National Forest wildland-urban interface (K. Wallen and E. Esch)\*

• 2014T9-014: Learning for and adapting to surprise: Resilience to water-related hazards in Germany and the US (A. Kung, J. Qui, and C. Begg)\*

## Theme 10. Data-Intensive Analysis & Modeling for Socio-Environmental Synthesis (34 proposals received). The following were supported:

• 2014T10-007: Wildfire management, ecosystem dynamics, and climate: The role of risk salience in driving ecological outcomes (A. Plantinga and N. Tague)\*

• 2014T10-012: Uncovering the role of global fishery collapse in future food insecurity and malnutrition (C. Golden and D. McCauley) Proposal was resubmitted for and funded as a single workshop.\*

• 2014T10-018: Examining the causes and consequences of environmental inequality over time: A datadriven computational approach (P. Mohai, M. Ash, and M. Collins)\*

• 2014T10-020: The value of water quality to lake recreation: Evidence from geotagged social media (B. Keeler and S. Wood)\*

• 2014T10-023: Growing the evidence base on forest conservation policies: A web-based evaluation tool (A. Blackman) Proposal was resubmitted for and funded as a single workshop.\*

• 2014T10-025: The socio-environmental data explorer (SEDE): Integrating social media and environmental data in cyberGIS to explore environmental hazard risk perception (V. K. Turner and E. Shook)\*

## Theme 11: Enhancing Socio-Environmental Research & Education (40 proposals received; Proposals are currently under review).

### **B.** Ventures

Between September 1, 2011 and March 1, 2015, SESYNC received 37 Venture applications. Eighteen have been approved for support.

The following have received support:

• Founding Venture: Experiment in teaching the socio-environmental synthesis process (A. Berkowitz, D. Hawthorne)

• 2012V-002: State policies to transform undergraduate STEM education in support of global sustainability (C. Middlecamp, M. George, J. Ramaley)

• 2012V-003: International Forestry Resources and Institutions (IFRI) research on forest social ecological systems for actionable science (A. Agrawal, P. Newton)

• 2012V-004: Using spatial data and analysis to understand the human impacts of ocean acidification (L. Pendleton, S. Cooley, L. Suatoni)

• 2012V-006: Linking biodiversity and ecosystem services: From expert opinion to prediction and application (B. Cardinale, E. Barbier)

• 2012V-009 (co-funded with NCEAS): Understanding how land-use change impacts the dynamics of vector-borne and water borne infectious disease of humans and domestic livestock (A. Dobson, N. Bharti)

• 2012V-011: Macroevolution of Ecosystem Services from Trees (J. Cavender-Bares, S. Polasky)

• 2013V-012 (co-funded with NIMBioS): Integrating human risk perception of global climate change into dynamic earth system models (B. Beckage, L. Gross, A. Zia)

• 2013V-016: Developing an integrated framework to model resilience of the coupled human/natural environment in tropical coastal systems (E. Hines and R. Lewison)

• 2013V-018: Advancing research on the perception, role, and function of urban green infrastructure by bridging the SESYNC synthesis process with an open community engagement process for software development (B. Minsker, S. Ahalt, and L. Band)

• 2013V-019: Renewable energy from wastewater: A synthesis of the agricultural, energy, and transportation sectors and environmental tradeoffs (S. Gabriel, L. Olson, and E. Gilmore)

• 2013V-021: Evidence and decision-support tools for controlling agricultural pests with conservation interventions (D. Karp and R. Chaplin-Kramer)

• 2013V-022: Models to unleash the power of citizen-science insect data for science, policy, education, and conservation (D. Sheldon, J. Calabrese, and L. Ries)

- 2014V-026: New tools to predict and prevent human-wildlife conflicts (N. Carter and A. Treves)\*
- 2014V-027: Linking local consumption to global impacts (K. Hubacek and K. Feng)

• 2014V-028: Synthesizing social-ecological systems change using cultural evolution theory (J. Brooks and T. Waring)

• 2014V-029: The effects of international trade and land grabbing on food security (P. D'Odorico and D. Seekell)\*

• 2014V-033: Restoration ecology and tropical forests (R.R. Rodrigues and A.G. Nave)\*

### C. Workshops

Between September 1, 2011 and March 1, 2015, SESYNC received 28 formal proposals for Workshops. Thirteen of these were funded. SESYNC also funded a variety of Workshops led by SESYNC staff. These have given the Center the opportunity to engage with a variety of communities including researchers, educators, and graduate students.

- 2012W-002: Citizen science, butterfly monitoring, and cyberinfrastructure (L. Ries; SESYNC Initiated)
- 2012W-003: S-E synthesis education: goals, resources, and tools (D. Hawthorne; SESYNC Initiated)

• 2012W-004: Visualization technologies to support research on human–environment interactions (J. JaJa; SESYNC Initiated)

• 2012W-005: Learning Exchanges for Conservation: An Examination of Lessons Learned (LExCELL) (K. Jenkins and S.H. Peckham)

• 2012W-006: Advancing tools and visualization techniques for representing modeled ecosystem service outcomes in simulated multi-player game environments (R. Costanza and L. Waigner)

- 2012W-007: Social networking and priority scholarship (R. Berndtson and J. Kramer; SESYNC Initiated)
- 2012W-008: Macro-evolution of ecosystem services (N. Kraft and W. Fagan; SESYNC Initiated)

• 2012W-011: Linking socio-environmental science to socio-environmental change (T. Miller and L. Olsson)

• 2012W-015: Globalizing our understanding of rural land use change (J. van Vliet and E. Ellis; project was originally submitted under Theme 2)

- 2013W-017: Cyberinfrastructure education in biology (M. Shelley; SESYNC Initiated)
- 2013W-019: Writing workshop for graduate students (D. Hawthorne; SESYNC Initiated)

• 2013W-023: Linking local consumption to global environmental impacts (K. Hubacek and K. Feng; project was originally submitted under Theme 4)

• 2013W-024: Socio-environmental synthesis research proposal writing workshop (R. Berndtson; SESYNC Initiated)

• 2013W-027: Influenza transmission and the built environment: Understanding modes of transmission in a sustainable future (D. Milton and J. Srebric)

• 2013W-028: Software Carpentry Workshop (M. Shelley; SESYNC Initiated)

• 2013W-029: Civic ecology practices: What role for self-organized community environmental stewardship in resilience to multiple stresses? (M. Krasny)

• 2014W-031: Environmental Decisions and Scientific Knowledge: Strategy and Opportunities for the Knowledge-to-Action Community of Practice (J. Kramer and J. Boyd; SESYNC Initiated)

• 2014W-033: How can social media can be used to explore coupled socio-environmental systems? (A. Crooks and N. Magliocca; SESYNC Initiated)

• 2014W-034: Integrating ecological data into investigations of urban scaling effects (M. Alberti; project was originally submitted under Theme 8)

• 2014W-035: Workshop for a modeling framework development for addressing drought impacts in Kenya: Dynamic systems and adaptation policies (D. Agusdinata; project was originally submitted under Theme 8)

• 2014W-036: Computational and temporal dimensions of environmental justice analysis (M. Collins; SESYNC Initiated)

• 2014W-037: A collaborative database for coastal fisheries and marine ecosystems (H. Fox and E. Darling)

• 2014W-042: Growing the evidence base on forest conservation policies: A web-based evaluation tool (A. Blackman; project was originally submitted under Theme 10)\*

• 2015W-043: Uncovering the role of global fishery collapse in future food insecurity and malnutrition (Golden, C. and McCauley, M.; project was originally submitted under Theme 10)\*

• 2015W-044: Developing interdisciplinary best practices and standards for the use of ecosystem services methods in federal agency decision making (L. Olander and R. Johnston)\*

SESYNC has hosted a variety of additional Workshops pertinent to the Center's mission, including NSFsponsored cyberinfrastructure meetings, planning sessions for partnership activities with the Renaissance Computing Institute (University of North Carolina), as well as sessions linked to the Keck Futures Initiative. SESYNC has also served as a venue for meetings of local academic programs, federal and state agencies, and NGOs.

### D. Foundations for S-E Synthesis

The Center's EAB challenged SESYNC to actively engage social science researchers, noting that this was essential in the early stages of the Center's evolution. SESYNC responded by initiating a new program, Foundations for S-E Synthesis, also referred to as Foundation Series, focused on understanding how the most recent theories and techniques from the social sciences can be applied to S-E issues, or

alternatively to specific S-E problems. SESYNC leadership has actively recruited sociologists, psychologists, and governance scholars to lead small workshops comprised chiefly of participants from their disciplines. Participants are asked to develop two products—a publication for their peers, and one of a more general nature designed for broad communities of natural and social scientists. The Center has now begun to recruit natural scientists to lead similar efforts.

• 2012F-001: Sociological perspectives on non-state actors in environmental governance (D. Fisher and C. Sirianni)

• 2012F-002: The limits of environmental governance (A. Agrawal and K. Waylen)

• 2012F-003: Large-scale natural resource conservation and restoration—Issues of governance (L. Scarlett and M. McKinney)

• 2012F-004: Time scales and the interplay between human response and management and ecological and ecosystem dynamics (A. Hastings and L. Maguire)

• 2013F-005: Contributions of psychology to socio-environmental problem solving (S. Clayton and P. Devine-Wright)

• 2013F-006: Food security, equity, and ecological sustainability: A multi-indicator, process oriented framework for food systems research (M. Jahi Chappell and H. Whitman)

• 2014F-007: Managing recreational fisheries as complex adaptive social-ecological systems (M. Wilberg, R. Arlinghaus, and O. Jensen)

• 2014F-008: Ecological restoration: Science, concepts, ethics (J.B. Callicott)

### E. Short courses

- Short course 1: Teaching socio-environmental synthesis with case studies (Summer 2013)
- Short course 2: Interactive visualization tools for socio-environmental data (Summer 2013)
- Short course 3: Computational Summer Institute (Summer 2014)
- Short course 4: Teaching socio-environmental synthesis with case studies (Summer 2014)
- Short course 5: Bayesian modeling for ecological and social scientists (Winter 2015)\*
- Short course 6: Teaching socio-environmental synthesis with case studies (Winter 2015)\*
- Short course 7: Teaching socio-environmental synthesis with case studies (Summer 2015)\*

### F. Fellowships

### 1. Postdocs

SESYNC has focused on building a strong community of postdoctoral fellows at the Center. Nine solicitations have been issued to date. We have received 223 applications overall to date and funded 17 fellows.

- Leslie Ries, an ecologist who works on biodiversity data flowing from citizen-science monitoring efforts, is currently focused on North American butterflies, including the use of these data to answer large-scale ecological questions. She was a Postdoctoral Fellow from 2011-2013 and is currently a SESYNC Research Fellow.
- William Burnside, an ecologist with interests in human macro-ecology and sustainability will develop a synthesis of the ecological, societal, and economic correlates of sustainability.
- Drew Gerkey, an evolutionary anthropologist analyzes cooperation and collective action among fishers and herders. He will use a behavioral ecology framework for synthesis of the sustainability of social networks in socio-ecological systems. [Hired February 2014 as an Assistant Professor of Anthropology at the University of Oregon.]
- Judy Che-Castaldo, a conservation biologist studying ecological monitoring and phytoremediation will conduct a synthesis of anthropogenic threat and demographic data to predict species extinction risk.
- Julio Postigo, a geographer interested in how climate change, political and economic trends, and land reform have affected pastoralist societies will analyze pastoral societies' responses to global environmental change. [Currently on leave.]
- Harish Padmanabha, a human ecologist who studies socio-ecological drivers of dengue risk and human mortality in dynamic urban ecosystems of Colombia will expand his work to develop detailed models that account for human vulnerability and urban socio-ecological heterogeneity relating to disease dynamics. [Hired January 2015 at Universidad del Norte (Colombia).]
- **Mary Collins**, an environmental sociologist who studies disproportionality and vulnerability in socio-ecological systems will focus on levels of pollution intensity, health risk and vulnerability of receptor human populations and ecological disruption in aquatic systems.
- Andres Baeza Castro, a theoretical and human ecologist, who looks at how cooperation behavior is shaped in semi-desert environments, is studying cooperation of a group of 200 rural communities in the semi-desert region of Chile in a gradient of environmental degradation and rainfall variability.
- Neil Carter, a conservation scientist interested in the dynamics and governance of complex S-E systems, particularly as they relate to wildlife conservation. At SESYNC he will synthesize datasets from disparate disciplines to develop a spatially-explicit, agent-based model of the reciprocal interactions between people and the environment in Chitwan.
- Lorien Jasny, a quantitative sociologist studying the belief networks among participants in the transdisciplinary project teams hosted by the National Socio-Environmental Synthesis Center (SESYNC). She will measure how these structures change over the period of collaboration, which will help understand how differences in belief structures are negotiated to develop group synthesis. [Hired March 2015, Exeter University in England.]
- **Kristin Powell**, a population and community ecologist who explores the ecological, ecosystem, and economic consequences of shifts in biodiversity. Her research at SESYNC examines anthropogenic pressures on biodiversity across increasing habitat areas, and the consequences of biodiversity loss for ecosystem services. [Ended fellowship in July 2014; currently Program Manager for the Smithsonian Tropical Research Institute in Washington, DC].
- **David Gill** specializes in marine resource management and his research focuses on identifying linkages between marine protected area (MPA) governance, human well-being, and ecosystem health. David's research is spearheaded by the World Wildlife Fund and affiliated with the

SESYNC Pursuit "Solving the Mystery of MPA Performance"; he works together with an interdisciplinary team of researchers and data from MPAs from around the world to identify key trends between MPAs and their social and ecological impacts.

- Elise Larsen, a population and community ecologist interested in population and community dynamics in relation to disturbance and environmental change. Her research at SESYNC focuses on developing new tools for studying population dynamics and phenology in Lepidoptera, with an emphasis on climate impacts.
- Matthew LaFevor will compile and assess large datasets on government-sponsored terracing projects, examining both human and environmental aspects of their design and sustainability. His work seeks to bridge the gap between the agronomic and conservation sciences to better understand where growing food and producing environmental services overlap or diverge on the landscape.
- **Kristina Hopkins** is broadly interested in coupled human-natural systems, particularly as they relate to water management in cities. At SESYNC, Krissy will focus on characterizing how stormwater management strategies change over time and what socio-political factors facilitate transitions in management styles. This work will identify policies and governance structures that catalyze transitions towards resilient, sustainable stormwater management systems
- Lauren Yeager is an ecologist whose primary research interests lie in understanding how humans are impacting coastal and marine ecosystems, and subsequently how changes in these systems may affect the ecosystem services they provide—specifically, human alterations to coastal landscapes and changes in biodiversity associated with overharvest may drastically alter the structure and function of marine communities.
- Jampel Dell'Angelo conducts research on the institutional drivers and governance conditions of virtual freshwater appropriation associated with global land grabbing and water grabbing. In collaboration with SESYNC Sabbatical Fellow Paolo D'Odorico, he is developing and applying a diagnostic approach tailored for the analysis of this expanding phenomenon.

SESYNC recently offered Skype interviews to 10 candidates and in-person interviews to 6 candidates for the sixth cohort of postdoctoral fellows who, for the second time, will carry out research proposals that were co-developed with research collaborators. For SESYNC new Postdoctoral Socio-Environmental Immersion Program, fellows will undertake synthetic projects focused on ecological systems and environmental change or on social systems and environmental change and they will also participate in workshops led by distinguished natural scientists and social scientists.

### 2. Sabbatical Fellows and Visiting Scholars

In years past SESYNC received a limited number of requests for visiting scholar and sabbatical fellowships. Previously, the goals of the applicant's research plans were quite distant from our mission, thereby limiting the utility of a visit to the Center—as such, most were declined. But in Year 4, that number increased and we hosted (and will continue to host) seven sabbatical fellows and visiting scientists.

• **Tom Hobbs** is a Senior Research Scientist at the Natural Resource Ecology Laboratory with a joint appointment in the Department of Ecosystem Science and Sustainability at Colorado State University. Dr. Hobbs' work focuses on population and community ecology of large mammals, both predatory and herbivorous. Dr. Hobbs returned to SESYNC following a productive visit to

our Center last December, during which he completed a book on the math behind Bayesian modeling (and why it works!). This past fall, he worked with SESYNC postdoc Dr. Mary Collins to prepare a winter 2015 short course for practicing natural and social scientists within the SESYNC community—including postdocs and those later in their career development—focused on accelerating learning of Bayesian modeling for these advanced researchers. The forthcoming book, titled *Bayesian Models: A Statistical Primer for Ecologists* and co-authored with Dr. Mevin Hooten, is now in production with Princeton University Press and will be available in early 2015.

- J. Baird Callicott: Dr. Callicott is a University Distinguished Research Professor of Philosophy at the University of North Texas. Dr. Callicott is interested in how philosophers can make both a creative contribution to the intellectual community and a practical difference in the world. This past fall, Dr. Callicott is lead a multidisciplinary SESYNC-supported working group tasked with synthesizing the implications of using an ecosystem services approach to ecological restoration from integrated philosophical, scientific, legal, economic, and ethical perspectives. Specifically, he was interested in exploring how the intrinsic value of nature interacts with the kinds of value that we express in economic terms and monetary metrics.
- Matt Baker: Dr. Baker is an Associate Professor of Geography & Environmental Systems at the University of Maryland, Baltimore County. This past fall, Dr. Baker explored how science can be better communicated to policy makers and managers. Part of his time at SESYNC focused on how to both achieve scientific consensus for scholarly research, as well as communicate research to non-expert audiences in ways that are at the same time accessible and transformative. Dr. Baker is also interested in how scientific evidence is used in legal processes and in developing policy.
- Paolo D'Odorico: Dr. D'Odorico (University of Virginia) joins SESYNC to examine how escalating demand for food, fibers, and biofuels by a growing and increasingly affluent global population is impacting the planet's limited land and water resources. He will spend much of his time at SESYNC on two interrelated SESYNC efforts: 1. an independent sabbatical project that investigates the impact of large-scale land acquisitions on local communities and on the local environment, and 2. a team synthesis project (co-led with Dr. David Seekell of Umeå University) that evaluates how the interconnection of food production and trade systems affects different communities' access to food.
- Ricardo Ribeiro Rodrigues: During his time at SESYNC, Dr. Rodrigues (University of São Paulo) along with Dr. Andre Nave will lead a Venture project that will synthesize, analyze, and evaluate extensive monitoring datasets on an unprecedented, large-scale forest restoration initiative launched in Brazil. This analysis will help: 1. define the most appropriate methodology for determining the impacts of tropical forest restoration on ecosystem services and economic outcomes, and 2. set baseline values for measuring the impacts of ecological restoration efforts. Additionally, they will work on developing a SESYNC research proposal—in collaboration with other Brazilian and American scientists—to investigate the effectiveness of efforts throughout various stages of forest restoration efforts on the recovery of important ecosystem services, such as freshwater provisioning and biodiversity.
- Andre Neve: Project Coordinator, Laboratory of Ecology and Forest Restoration, University of São Paulo; Director, BIOFLORA Restoration Technology; Director, NBL Environmental Engineering. See above for Dr. Rodgrigues.

• **Cristina Vidal:** Ms. Vidal will be joining Drs. Rodrigues and Neve as a student. See above for further description.

#### 3. Policy and Practice Fellowships

SESYNC has received a limited number of requests for Policy and Practice Fellowships and funded its first fellow this year.

• Antonia Sohns is a freelance writer and a Water and Energy Analyst at The World Bank. Over the next year, Ms. Sohns will meet with research groups to gather updates on the research being conducted, distill the main issues they seek to tackle, and convey their work to the public through interviews and videos. She will also interview the research groups to learn what the main challenges are that the groups face in completing interdisciplinary work. Given that communicating science to a broad audience in an engaging medium is an ongoing challenge, Ms. Sohns seeks to convey the work of SESYNC researchers to the public, media and policy-makers.

### 4. SESYNC Research Fellows

- Nicholas Magliocca is a Computational Research Scientist for SESYNC. Dr. Magliocca's research uses agent-based virtual laboratories to investigate the dynamics of human-environment interactions and their consequences for environmental and economic sustainability. Of his time at SESYNC, 50% of his research focuses on modeling human-environmental interactions and 50% of his time is served in an advisory capacity. He provides programmatic and administrative leadership for SESYNC's "Data-Intensive Analysis and Modeling" program, development and implementation support for the "Data to Motivate Synthesis" program, and as needed, modeling and/or spatial data analysis support for funded working groups.
- **Kristal Jones** is a Food Systems Research Fellow/Research Associate for SESYNC and will be starting in April. Dr. Jones' research uses mixed methodologies to analyze the humanenvironment interactions present in agricultural production, and to identify the impacts of cross-scalar changes and perturbations to the social and ecological foundations of food systems. At SESYNC, Kristal will manage the SESYNC-USDA collaborative "Data to Motivate Synthesis program", which will support data integration, analysis and visualization to catalyze research around building resilient food systems. She will also develop a food systems research program within SESYNC, with both domestic and international research projects.

### II. Portfolio of Projects and Activities

Since its inception, SESYNC has received 254 applications for its core programs (Pursuits, Ventures, and Workshops) and funded 66 of these proposals (44.3%), excluding SESYNC-initiated Workshops and Theme 11 as it is currently under review. SESYNC received 223 applications for its Postdoctoral Program (6 RfPs to date) and funded 15 fellows from those calls (6.7%). A summary of applications received and funded since SESYNC's inception for each program can be found in the tables below:

### A. Pursuits

	Number of Applications	Number Accepted	Total Number of Funded Participants
2012T1 (Theme 1)	11	5	105
2012T2 (Theme 2)	9	1 + 1 as a Workshop	20
2012T3 (Theme 3)	8	5	111
2013T4 (Theme 4)	5	1 as a Workshop	-
2013T5 (Theme 5)	8	3	93
2013T6 (Theme 6)	10	3	38
2013T7 (Theme 7)	28	6	70
2014T8 (Theme 8)	22	2 + 2 as Workshops	43
2014T9 (Theme 9)	14	6	47
2015T10 (Theme 10)	34	4 + 2 as Workshops	TBD
2015T11 (Theme 11)	40	TBD	TBD
Total	189	35 Pursuits + 6 Workshops	601

### **B.** Ventures

	Number of Applications	Number Accepted	Total Number of Funded Participants
Venture Applications	37	18	337

### C. Workshops

	Number of Applications	Number Accepted	Total Number of Funded Participants
Workshop Applications (external)	28	13	194
Workshops Overall	44	29	582

### D. Fellowships

### 1. Postdoctoral Fellowships

POSTDOCTORAL FELLOWSHIPS	Number of Applications	Number Accepted
Winter 2012 (General)	20	2
Spring 2012 (Social Science)	13	2
Fall 2012 (General)	17	2
Spring 2013 (General)	28	4

Spring 2013 (Computational)	6	1 (hired as computational research fellow)
Fall 2013 Luc Hoffman-SESYNC Partnership	41	1
Spring 2014 (General)	<ul> <li>Postdocs: 199 pre- screened; 106 cleared; 33 applied</li> <li>Mentors: 44 pre- screened; 40 applied</li> </ul>	4
Fall 2014 (Computational)	4	TBD
Fall 2014 SESYNC-USDA Food Systems Resilience to Climate Change Program – Postdoc (for Spring 2015)	6	1 (hired as research scientist)
Fall 2014 (SE Immersion Program for Fall 2015)	<ul> <li>Postdocs: 118 pre- screened; 111 cleared; 55 applied</li> <li>Mentors: 84 pre- screened; 77 applied</li> </ul>	TBD
Winter/Spring 2015 SESYNC-LTER Postdoctoral Synthesis Fellowships (for Fall 2015)	TBD	TBD
OVERALL	223	15

### 2. Other fellowships

OTHER FELLOWSHIPS	Number of Applications	Number Accepted
SABBATICAL FELLOWSHIPS	9	7
VISITING SCHOLAR	5	4
POLICY & PRACTICE FELLOWSHIP	1	1
SCIENCE COMMUNICATIONS FELLOWSHIP	11	2
OVERALL	26	14

### E. Short Courses

	Number of applications	Number of instructors & participants
Short Course 1 (SES Summer 2013)	56	45
Short Course 2 (Viz Tools)	19	30
Short Course 3 (CSI)	n/a	31
Short Course 4 (SES Summer 2014)	133	37
Short Course 5 (Bayesian Models)	54 external and 12 internal	20 + 2 instructors
Short Course 6 (SES Winter 2015)	19	16 + 4 instructors
Short Course 7 (SES Summer 2015)	TBD	TBD
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OVERALL	293	185

# III. Profile of SESYNC Participants and Demographic Analysis

# A. SESYNC Participants

SESYNC has funded 1674 individual participants since its inception. Approximately 208 individuals have participated in more than one SESYNC program. For each funding year, the total number of funded participants is as follows:

- Year 1 (September 1, 2011 August 31, 2012): 324
- Year 2 (September 1, 2012 August 31, 2013): 712
- Year 3 (September 1, 2013 August 31, 2014): 1003
- Year 4 (September 1, 2014 present): 515

The following numbers reflect participants funded within each program thus far:

- Pursuits: 527 total
  - o Theme 1: 105
    - o Theme 2 & 4: 20
  - o Theme 3: 111
  - o Theme 5: 93
- Ventures: 337
- Workshops: 582
- Foundations: 110
- Short Courses: 185
- Fellowships: 30

#### B. Demographic Analysis

SESYNC participants are asked to fill out a demographic survey prior to each meeting. Of SESYNC participants, approximately 917 unique individuals from our Pursuit, Workshop, Venture, Foundation, and Short Course programs filled out a survey.

1. Gender and Geographic Diversity

Of those who filled out a survey, there are 516 men and 401 women (56.3% and 43.7%, respectively). Approximately 77% of participants are from the United States and 33% of participants come from 41 countries around the world. Those from the US come from 48 states in addition to Washington, DC.

- o Theme 6:38
- o Theme 7: 70
- o Theme 8: 43
- o Theme 9: 47



Figure 1. World map of geographic diversity of SESYNC participants



Figure 2. US map of participant State diversity

#### 2. Race/Ethnicity

Of those who filled out a demographic survey (N=917), SESYNC's race and ethnic diversity of participants is illustrated in the table below:

		RACE							
		Asian	Asian/White	Black/African American	Native American/ Alaska Native	Native Hawaiian or Other Pacific Islander	White	No Response	
ETHNICITY	Hispanic/Latino	0.1%	0.0%	0.1%	0.1 %	0.2%	3.2%	1.4%	
	Non-Hispanic	8.3%	1.0%	2.2%	0.2%	0.0%	65.8%	1.6%	
	No response	1.5%	0.1%	1.0%	0.1%	0.0%	5.6%	7.5%	
TOTAL RACE	Combined Ethnicity [Hispanic/Non- Hispanic/No response]	9.9%	1.1%	3.3%	0.4%	0.2%	74.6%	10.5%	

Figure 3. Table of self-reporting race and ethnicity percentages for SESYNC participants

SESYNC's race and ethnic diversity of participants is illustrated in the percentages below versus U.S. doctoral degrees awarded, according to the National Science Board Science and Engineering Indicators 2014. Given that SESYNC's survey differs from the NSB survey, our percentages have been adjusted to reflect their same categorization.

	RACE						
	White	Asian or Pacific Islander	Black	Hispanic	American Indian or Alaska Native	Other or Unknown Race or Ethnicity	No response
SESYNC participants	71.4%	9.8%	3.2%	5.1%	0.3%	1.1%	9.1%
All degrees, US Citizen and Permanent Resident (2012)	67.1%	7.5%	9.0%	6.0%	0.5%	9.9%	n/a
All Biological Science Degrees, US Citizen and Permanent Resident (2012)	67.6%	11.7%	4.7%	5.8%	0.6%	9.6%	n/a

Figure 4. Table of SESYNC self-reporting race percentages vs. doctoral degrees awarded

#### 3. Transdisciplinary Activity

Of those reporting their transdisciplinary activity (participation in inter- or trans-disciplinary research, training, and/or engagement), the responses are as follows: never: 2%; sometimes: 30%; and frequent: 68%.

#### 4. Self-characterization

Participants are also asked to self-characterize according to the categories of natural scientist, social scientist, computer scientist, more than one (multi), policy, NGO, government, business, or other. Of those reporting from our Pursuit, Venture, Workshop, and Foundation programs, there are 273 natural scientists (34%), 179 social scientists (22%), 23 computer scientists (3%), 66 self-reporting as NGO/government/policy/industry (8%), 142 self-reporting as both natural and social scientist (17%), 109 self-reporting as other or multi (13%), and 21 as no response (3%) overall.

#### a. Self-characterization for participants overall



Figure 5. Participant self-characterization overall



# b. Self-characterization for participants within each program

Figure 6. Participant self-characterization within Pursuits, Ventures, Workshops, and Foundations

#### 5. Institutional Status

Participants are also categorized as "academics" or "knowledge users" based upon their selection for "institutional status" within the demographic survey. Academics are those within academic institutions as graduate/postdoc students and teaching or research faculty and knowledge users are those within the policy, business/industry, government, or NGO sectors.

Of those reporting from our Pursuit, Venture, Workshop, and Foundation programs, there 592 academics and 198 knowledge users. Of the knowledge users, 51% come from the NGO/non-profit sector, 42% from the government sector, and 8% from the business/industry sector.

In the pie charts below, the participant institutional status is depicted overall and for each program, in addition to the disciplinary overall and sub-disciplinary expertise breakdown for each program.



#### a. Academics and knowledge users overall

Figure 7. Academics and knowledge users overall



# b. Academics and knowledge users within each program



#### c. Disciplinary expertise overall



#### Figure 9. Disciplinary expertise for Pursuits, Ventures, Workshops, and Foundations



#### d. Disciplinary expertise within each program and by individual project

Figure 10. Participant disciplinary expertise overall for each program



Figure 11. Participant disciplinary expertise for individual projects supported within each program

#### e. Subdisciplinary expertise

On the next page, a bar graph (Figure 12) depicts the subdiscplinary expertise of participants. Each color corresponds to a discipline which can be found in the legend at the bottom of the page.



# **Subdisciplines**

# Appendix 2. SESYNC Products

#### **Appendix 2. SESYNC Products**

# **EXECUTIVE SUMMARY**

This appendix only lists those funded participants who responded to our request for information regarding their products; thus it is likely an underestimate. Additionally, several funded projects have not held their first meeting and will similarly not be listed.

#### > Product summary for all SESYNC funded projects:

- Journal articles:
  - o Published, in press, or accepted: 105
  - o Under review: 30
  - o Submitted: 24
- Book/book chapters: 13
- White papers: 9
- Presentations: 228
- Proposals/ grants for follow-on research (regardless of status): 58
- Students involved: 105

#### > Product summary for Pursuits, Ventures, Workshops, and Foundations

	PURSUITS	VENTURES	WORKSHOPS	FOUNDATIONS
Journal articles: Published, in press, or accepted	30	5	6	10
Journal articles: Under review	12	2	7	2
Journal articles: Submitted	11	1	-	5
Book/book chapters	3	2	2	1
White papers/ guidebooks	7	-	1	-
Presentations	76	69	10	1
Proposals for follow-on funding/grants	17	18	7	1
Students trained/ involved	35	43	3	5

# **THEME 1: Ecological Wealth & Changing Human Populations**

#### Conservation & Welfare; PIs: Brendan Fisher and Taylor Ricketts

Project Title: "Evaluating relationships among human health and welfare, ecological condition, and natural resource governance"

#### Publications:

#### Journal articles, in review:

- 1. Fisher, B., D. Adams, A. Ellis, H. Fox and E. Selig (second revision: *Marine Ecology Progress Series*). "Health, Wealth, and Education: human wellbeing and coastal populations."
- 2. Fisher, B. and R. Naidoo (in Review at *Nature*). "The Geography of Gender Inequality."
- 3. Fisher, B., R. Naidoo, J. Guernier, D. Mullins, D. Robinson and E. H. Allison (in review: *Food Security*). "Farmers Need Fish, Fishers Need Farms: Integrating fisheries and agricultural programs for food security."
- Pailler, S., R. Naidoo, N. D. Burgess, O. E. Freeman and B. Fisher (second revision: *PlosOne*).
   "Impacts of Community Based Natural Resource Management on Wealth, Food Security and Child Health in Tanzania."

#### Journal articles, submitted:

1. Fisher, B and Allison, E and Robinson, D and Guernier, J and Mullins, D and Naidoo, R. Fish, Farms, and Food Security. *Science*.

#### **Presentations:**

- 1. Ecosystems and human health. Invited seminar. Natural Capital Project. October 2014.
- 2. Show me (more than) the money: Ecosystem services and human health. ACES biannual meeting, Washington DC. December 2014.
- 3. Is nature good for you? Linking ecosystems and human health. Invited seminar. UC Berkeley, Environmental Science, Policy, and Management. January 2015.
- Fisher, B., Global Coastal Health in Small-Scale Fisheries. Rockefeller Foundation Ocean and Fisheries Initiative. Coastal Resources Center, University of Rhode Island Webinar. November 2014.
- 5. Fisher, B., Fish, Farms and Food Security: Building resilience in diversified coastal livelihoods. 2nd World Small-Scale Fisheries Congress. Merida, Mexico, Sept 2014.
- 6. Fisher, B. Fish, Farms and Food: linking conservation and development in Coastal Mozambique. North America Congress for Conservation Biology. Missoula, Montana, July 2014.
- 7. NGO sponsored 2014. Human Welfare on the World's Coastlines (Fisher World Wildlife Fund, Washington DC, Jan 2014).
- 8. Foundation sponsored meeting 2013. The Geography of Global Gender Inequality (Fisher Bellagio Center, Lake Como Italy, August 2013).
- 9. College/University 2013. Coastal Livelihoods, Coastal Food Systems (Fisher Stanford University Center for Ocean Solutions, Nov 2013).

#### Proposals submitted for follow-on research:

- 1. Ricketts. T.H., PI. Watersheds and Health. Proposal to Luc Hoffmann Institute, WWF. Submitted (very close to awarded). \$99,000.
- Ellis, Alicia, et al. Modeling the effects of environmental, behavioral, economic, social, and demographic factors on mosquito-borne diseases. US National Science Foundation EEID. December 2013 (not funded)
- Submitted: National Science Foundation, Ecology and Evolution of Infectious Diseases (\$1.6M) (A.M. Ellis, T.H. Ricketts, B. Fisher, R. Naidoo, A. Dobson).

#### Students trained/involved with project:

- 1. Drew Hart, University of Maryland
- 2. Tim Truer, PhD Student, Princeton University involved in project and working groups

#### Data, software, tools, and websites produced from synthesis efforts:

Large database of all Demographic and Health Surveys, covering more than 1 million individuals in 90 countries over 35 years.

#### Stories related to your synthesis efforts:

It turns out that what we were trying to do was a bit harder than envisioned. Building a database with raw data from surveys of over 50 countries with over a million households and many million observations had some troubles. But at every step SESYNC has had either a solution or the right steps towards a working alternative. Our effort is still on-going, but more than ever I am convinced of the usefulness of the end product (the largest database linking human health and welfare with biophysical environmental data). One of our findings that came as a side result for work we were trying to do was that we produced a map across 47 developing countries showing the inequality in land ownership and household wealth between male-headed and female-headed households. We show that male-headed households have on average 12% more asset wealth and over 300% more land wealth, when compared to female-headed households. This paper is in review at Nature. Again this paper was not planned, but shows the kind of easy big-picture questions you can ask when you have a database as the one we are building at SESYNC.

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

I have had several meetings with headquarter staff and field personnel at both WWF and CARE, to discuss our project and to field from them what kinds of questions would be most useful for them to have answers too. Once we get a full-functioning database, we will host a webinar with NGOs working in the field to understand the database, such that they can feed researchers with questions with practical implications.

#### Publicity in popular press:

1. *Nature*. Not specifically for the SESYNC project but for work that has the same line of research as our SESYNC project. <u>http://blogs.nature.com/soapboxscience/2014/04/11/world-wildlife-funds-dr-brendan-fraser-on-improving-fish-diversity-and-conservation-agriculture-in-mozambique</u>

#### Where Cities Get Their Water; PIs: Rob McDonald and Deborah Balk

Project Title: "Creating a global database of how different populations within cities are dependent on freshwater ecosystem services"

#### **Publications:**

- 1. McDonald, R. I. and D. Shemie (2014). Urban water blueprint: Mapping conservation solutions to the global water challenge. Washington, DC. Available online at: nature.org/waterblueprint, The Nature Conservancy.
- 2. Padowski, J. C. and Gorelick, S.M (2014). Global analysis of urban surface water supply vulnerability. Environmental Research Letters Volume 9 Number 10. doi:10.1088/1748-9326/9/10/104004
- 3. McDonald, RI and Weber, K and Padowski, J and Florke, M and Schneider, C and Green, PA and Gleeson, T and Eckman, S and Lehner, B and Balk, D and Boucher, T and Grill, G and Montgomery, M (2014). Water on an urban planet: urbanization and the reach of urban water infrastructure. Global Environmental Change.

#### Database:

1. Database being built linking biophysical data and social data across 60,000 village clusters from around the developing world.

#### Rural Forests; PIs: Brian McGill and Kathleen Bell

Project Title: "Rural forest communities at a tipping point? Trends and actionable research opportunities"

#### **Publications:**

#### Revised and resubmitted

 Morzillo, A., C. Colocousis, D. Munroe, K.P. Bell, S. Martinuzzi, D. Van Berkel, M. Lechowicz, B. Rayfield, and B. McGill. 2015. Communities in the middle: Interactions between drivers of change and place-based characteristics in rural forest-based communities. Revised and resubmitted to Journal of Rural Studies.

#### **Presentations:**

- 1. Kovacs, K., R. Haight. Determinants of Spatial Variation in Economic Development in Rural Forests in the United States. Selected Poster, Agricultural and Applied Economics Annual Meeting, Minneapolis, MN, 2014.
- Bell, K.P. 2013. Messy landscapes: interactions among urbanization, forest ecosystem management, and climate change. Department of Forestry and Wildlife Ecology, University of Wisconsin-Madison, Madison, WI, September 27, 2013 (hosted by Sebastian Martinuzzi and Volker Radeloff).

#### Students involved with project and/or trained:

 Four post-doctoral research fellows were trained as part of the project (Derek van Berkel, Ohio State University (advisor: Darla Munroe); Sebastian Martinuzzi, University of Wisconsin Madison (advisor: Volker Radeloff); Bronwyn Rayfield, McGill University (advisor: Andy Gonzales); and Benoit Parmienter, University of Maine (advisor: Brian McGill).

#### Data, software, tools, and websites produced from synthesis efforts:

 Spatial database of rural forested landscapes (Forests where People Live and Work) Extent: Contigous United States; Unit: 10km by X 10km grid; Key innovation – combining social (census) and biophysical (landcover) at national scale.

#### Stories related to your synthesis efforts:

- 1. We had a great group of researchers from many different fields and the PIs created spaces for the group as a whole to build on this diversity and advance new insights about rural forested landscapes. Our group's most novel insights came from working through points of tension across disciplines.
- 2. One manuscript has been revised and resubmitted to Journal of Rural Studies, and is a collaboration among nine members of the research team. This paper is a conceptual view of drivers of change of rural forest-based communities. Disciplines of the four members of the research team who led this manuscript include geography, economics, rural sociology, and human dimensions. Although the full group struggled with a definition of the area we were trying to define ("George"), contribution from multiple disciplines allowed for a more-holistic (and way more interesting!) view of the topic and the opportunity to view patterns and relationships that might not have revealed themselves as fully otherwise.
- 3. In this group, we shared the big insights and puzzles from our respective projects, and it was nice to have the support of the group to talk through, and then revise as needed, my tentative conclusions about my study area in light of their experience and expertise. Over a few meetings, as a group, we began to move toward synthesis and shape overarching arguments about the challenges that all of our communities face and the varied ways communities respond to them. In this way, we derived some common understanding that respected the socioecological diversity of each community and region, while also identifying common processes across context. I felt that how we came together to forge cross-group understanding was very valuable for me in extending the potential impact of my personal study area and project. The facilities and infrastructural support (meeting space, travel monies, social events) will serve to build some career-long relationships. I so loved working with these people, I can't wait to develop collaborative projects with some of them.
- 4. I personally learned a lot about (1) different disciplinary approaches (including both basic methodological orientations and specific innovative/sophisticated methods) to understanding issues that transcend disciplines, and (2) the ways in which the issues and problems that I'm most drawn to connect to those studied by researchers from other fields. Beyond that, and the whole thing being an overwhelmingly positive experience in terms of the people involved, I think the time spent there will hopefully result in long-term collaboration that has started with the manuscript(s) we've developed. Related to the working structure of the group, I do think it's interesting that the paper sub-groups were largely natural science fields on one side and social science fields on the other, so to some extent disciplinary distinctions were reproduced in the context of an integrative endeavor. I don't have a problem with that at all, but it did strike me as interesting. The paper we produced does meaningfully represent synthesis of multiple fields,

though perhaps more so in terms of integrating various social scientific approaches to understanding an issue with fundamentally ecological dimensions. But I think ultimately the time spent at SESYNC will provide the foundation for truly synthetic, collaborative, interdisciplinary, etc. approaches to understanding the types of issues laid out in the project proposal via new projects and proposals that spin out of it (and that are potentially situated in the framework we developed in that manuscript).

5. The interdisciplinary setting was fascinating. At times, we made progress quickly, identifying creative ways to improve social and ecological understanding of forest communities and landscapes. For example, it was rewarding to learn firsthand and quickly about several quantitative ecological methods and then modify and apply these approaches to social processes. I learned much from observing the collaborative work of our group's scholars in sociology, economics, human geography, and human dimensions; they worked hard to find common ground and set the stage for our synthesis work. These distinct, productive types of exchange set the stage for more substantive interactions and the emergence of unifying datasets and frameworks. Collectively, they remind us all of the opportunities to learn by integrating our respective theories and approaches. In other situations, we had to find ways to muddle through. For example, we had difficulties agreeing on a name for the places/landscapes) of primary interest to the group. We used the phrase "George" as a placeholder. And it worked fabulously.

#### **Comments:**

SESYNC provided our working group with an amazing set of resources - wonderful staff, incredible work spaces, and strong leadership. Thank you all very much. It is very impressive to observe the center's willingness to adapt and experiment with different approaches. Your open-ness to feedback and strong communication networks will serve you well.

#### Suggestions for improving the effectiveness of pursuit working groups:

Allow shorter group meetings (5-day meetings were difficult), keep refining the RFPs and having diverse RFPs to support science that best aligns with the Center's goals, provide (optional) tips to Co-PIs for running a social-environmental working group, and maybe increase/incentivize accountability more with some type of intermediate benchmarks. As we pursue new outreach efforts, please let us know of any interactions you may have with the public resulting from these efforts.

Sustainable Urban Ecosystems in China; PIs: Wei-Ning Xiang and Joan Nassauer Project Title: "Synthesis to link understanding, planning, and management of urban ecosystems in China"

#### **Publications:**

#### Book chapter:

 Nassauer, Joan Iverson (2013). {Landscape as Method and Medium for the Ecological Design of Cities}. *Resilience in Ecology and Urban Design: Linking Theory and Practice for Sustainable Cities* Pickett, S.T.A and Cadenasso, M. L. and McGrath, B. SPRINGER. 79-98

#### Journal articles:

- Ahern, Jack and Cilliers, Sarel and Niemela, Jari (2014). The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. Landscape and Urban Planning. 125 254-259
- Cilliers S, M du Toit, J Cilliers, E Drewes, F Retief (2014). Sustainable urban landscapes: South African perspectives on transdisciplinary possibilities. *Landscape and Urban Planning*. 125 260-270
- 4. Douglas, Ian (2014). The political filter in the local implementation of initiatives relating to urban ecology. *Landscape and Urban Planning*. 125 312-319.
- 5. Nassauer, J.I. and Wu, J.G. and Xiang, W.-N. (2014). Actionable urban ecology in China and the world: Integrating ecology and planning for sustainable cities. *Landscape and Urban Planning*. 125 207-208.
- 6. Nassauer, Joan Iverson (2012). Landscape as medium and method for synthesis in urban ecological design. *Landscape and Urban Planning*. 106 221-229.
- Nassauer, Joan Iverson and Raskin, Julia (2014). Urban vacancy and land use legacies: A frontier for urban ecological research, design, and planning. *Landscape and Urban Planning*. 125 245-253.
- 8. Niemela, Jari (2014). Ecology of urban green spaces: The way forward in answering major research questions. *Landscape and Urban Planning*. 125 298-303
- 9. Opdam, Paul and Nassauer, Joan Iverson and Wang, Zhifang and Albert, Christian and Bentrup, Gary and Castella, Jean-Christophe and McAlpine, Clive and Liu, Jianguo and Sheppard, Stephen and Swaffield, Simon (2013). {Science for action at the local landscape scale}. *Landscape Ecology*. 28 1439-1445.
- Shi, Peijun and Yu, Deyong (2014). Assessing urban environmental resources and services of Shenzhen, China: A landscape-based approach for urban planning and sustainability. *Landscape* and Urban Planning. 125 290-297
- 11. Steiner, Frederick (2014). Frontiers in urban ecological design and planning research. *Landscape and Urban Planning*. 125 304-311.
- Wang, Zhifang and Tan, Puay Yok and Zhang, Tao and Nassauer, Joan Iverson (2014). Perspectives on narrowing the action gap between landscape science and metropolitan governance: Practice in the US and China. *Landscape and Urban Planning*. 125 329-334
- 13. Wolch, Jennifer R. and Byrne, Jason and Newell, Joshua P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landscape and Urban Planning*. 125 234-244.

#### Megaregion Sustainability; PIs: James Connolly and Steward Pickett

Project Title: "Urban ecological sustainability: Multi-level governance of water, energy, and carbon in the northeast mega-region of the United States"

#### Publications:

1. Childers, Daniel L. and Pickett, Steward T.A. and Grove, J. Morgan and Ogden, Laura and Whitmer, Alison (2014). Advancing urban sustainability theory and action: Challenges and opportunities. *Landscape and Urban Planning* 125 pp 320-328.

#### Submitted:

 Connolly, J. J. T., S. T. A. Pickett, C. G. Boone, D. R. Fisher, L. R. Hutyra, S. M. Raciti, W. M. Wolheim, S. S. Kaushal, J. Oneil-Dunne, J. M. Grove, E. S. Svendsen, S. A. Drzyzga, C. A. Polsky, C. Welty, D. H. Locke, and A. C. Whitmer. Emerging social and environmental challenges in urbanizing megaregions. Urban Ecosystems, submitted.

# THEME 2 & 4: Globalization & Socio-Environmental Systems

#### Global Live Plant Trade; PIs: Becky Epanchin-Niell and Andrew Liebhold

Project Title: Globalization of the live plant trade: Informing efficient strategies for reducing non-native pest invasion

#### **Publications:**

#### In review:

1. Epanchin-Niell, R.S. and A. Liebhold. In review. "Benefits of invasion prevention are constrained by lags and timing of invasion impacts." *Ecological Economics*.

#### In prep/to be submitted:

- Eschen, R., Britton, K., Brockerhoff, E., Burgess, T., Dalley, V., Epanchin-Niell, R.S., Gupta, K., Hardy, G., de Hoop, M.B., Huang, Y., Kenis, M.1, Kimani, E., Li, H.-M., Olsen, S., Ormrod, R., Otieno, W., Sadof, C., Tadeu, E., Theyse, M. 2016. International variation in phytosanitary legislation and regulations governing importation of live plants. Biological Invasions. (to be submitted Feb., 2015)
- 3. Chen, C., R. Epanchin-Niell, and R.G. Haight. Optimal acceptance sampling with budget constraints: An application to inspection of U.S. live plant imports. Operations Research; to be submitted March 2015.

#### **Presentations:**

- 1. Haight, R.G., C. Chen, R. Epanchin-Niell. Optimal Acceptance Sampling to Prevent the Introduction of Regulated Pests on U.S. Live Plant Imports. INFORMS Annual Meeting, San Francisco, CA. November 9-13, 2014. (invited) **[NEW]**
- Haight, R.G., C. Chen, R. Epanchin-Niell. Optimal Acceptance Sampling to Prevent the Introduction of Regulated Pests on U.S. Live Plant Imports. Conservation Biology Seminar Series, University of Minnesota. September 22, 2014. (invited)
- Liebhold, A.M., R. Epanchin-Niell. "Temporal distribution of damages are critical determinants of the economic valuation of invasive species impacts", presented in symposium, "Novel anthropogenic activity datasets and predicting long range introductions of invasive pests", Entomological Society of America Annual Meeting, Portland, OR Nov. 15-19, 2014.
- 4. Liebhold, A.M. "Historical Insect Invasions of North America: Pattern and Process", presented at workshop, "Drivers, mechanisms & Impacts of Insect Invasions", November 24-26, 2014 Center for Biological Invasions, Stellenbosch University, Stellenbosch, South Africa (keynote presentation)
- Liebhold, A.M. "Plant Smuggling A Pathway For Invasions By Damaging Non-Native Forest Insects And Pathogens", presented in a session "Research On Pathway Risk Management And Phytosanitary Policy To Prevent Invasions Of Forest Insects And Pathogens", IUFRO World Congress, October 5-11, 2014, Salt Lake City.

- 6. Liebhold, A.M. "Forest Insect and Disease Invasions in the US: How Are They Getting Here and What Can be Done About it?" seminar, Auburn University School of Forestry and Wildlife Sciences September 24, 2014, Auburn, AL.
- Liebhold, A.M. "Ecology and Management of Invasive Species". Workshop: "Manejo de plagas forestales invasoras: tendencias y desafíos en un mundo cambiante" (sponsored by Instituto Nacional de Tecnología Agropecuaria), Rancho El Fortin, March 11, 2014, Bariloche, Argentina (keynote).
- 8. R. Epanchin-Niell, C. Chen, R.G. Haight. Invited talk at IUFRO (International Union of Forest Research Organizations) World Congress 2014. "Designing Cost-Effective Inspection Programs and Phytosanitary Policy for Reducing Pest Risk from Live Plant Imports." October 11, 2014.
- R.S. Epanchin-Niell and A. Liebhold. "Temporal patterns of invasion damages and implications for mitigation." 25th USDA Interagency Research Forum on Invasive Species, Annapolis, MD, Jan 7-10, 2014.
- 10. A.M. Liebhold, "Forest Insect and Disease Invasion Pathways in the USA and their Management", Chinese Academy of Sciences, Beijing, China Oct. 21, 2013
- 11. A.M. Liebhold, "A historical perspective on international plant quarantine regulation in the US and its consequence" presented at joint meeting of IUFRO 7.03.12 "Alien invasive species and international trade joint with the International Forestry Quarantine Regulation Group, Qingdao, China Oct. 27-31, 2013.
- 12. A.M. Liebhold, "Overview of forest insect and disease invasion pathways" 25th USDA Interagency Research Forum on Invasive Species, January 7-10, 2014, Annapolis, MD
- 13. A.M. Liebhold, "Globalization and its Consequences to Forest Insect and Disease Invasions", National Socio-Environmental Synthesis Center, Feb. 4, 2014, Annapolis, MD
- 14. C. Chen, "How do live plant shippers respond to inspection scheme changes? Evidence from the Propagative Material Release Program." Research in Environmental Economics Seminar, Harvard University, March 7, 2014.
- 15. R.S. Epanchin-Niell. "Designing cost-effective inspection programs and phytosanitary policy for reducing pest risk from live plant imports" at XXIV IUFRO World Congress 2014 ("Sustaining Forests, Sustaining People: The Role of Research"), Salt Lake City, UT, 5-11 October 2014.
- 16. C. Chen, R. Epanchin-Niell, R. Haight. "Optimizing acceptance sampling: An application to U.S. live plant imports inspection", INFORMS meeting, San Francisco, CA, Nov 2014.

#### Database/tools developed:

1. US Plant import and pest interception data 2010-2013; data on plant type, family, and relatedness to genera found in the US for all US live plant imports.

#### Follow-on funding/proposals submitted:

- 1. Risk-Based Sampling of Imports: Policy Design for Minimizing Entry of Pests and Pathogens. USDA APHIS. Jul 01, 2014 to Sep 30, 2015. PIs Mike Springborn and Rebecca Epanchin-Niell.
- 2. Michael Springborn (UC Davis) and Bob Griffin (USDA) met through the SESYNC working group and subsequently worked together as part of a larger team that successfully applied for NSF funding to support related research. The grant proposal to examine the Risks of Animal and Plant Infectious Diseases through Trade was awarded in March 2014 through the NSF program on Ecology and Evolution of Infectious Diseases (EEID).

#### New collaborations:

1. Andrew Liebhold entered into a collaboration with the new European Union COST Action FP1401 "Global Warning" (<u>http://www.cost.eu/domains\_actions/fps/Actions/FP1401</u>)

#### Students trained:

- 1. SESYNC Post Doc Judy Che-Castaldo participated in the first two work group meetings.
- 2. CuiCui Chen began in the work group following her first year in an economics PhD program at Harvard University. She has since taken the lead on two of the subprojects coming out of the group and will likely include subsequent work on this topic part of her dissertation. SESYNC was her first exposure to work on invasive species and interaction with agency personnel and other stakeholders.

#### Stories related to your synthesis efforts:

Our pursuit had built communicative bridges between government regulators, university faculty, government researchers and industry (nursery) advocates. Out of this has emerges some very useful and novel insights into the problem of how plant imports serve as pathways for invasions by plant pests. This will result not only in the exploration of this topic in the scientific literature but also changes in import regulatory policy that should greatly improve the situation in the future. **[NEW]** 

# THEME 3: Assessment & Modeling of Ecosystem Services

Businesses & Biodiversity; PIs: Sally Duncan and Steve Elliot Project Title: How will businesses speak biodiversity?: Novel and adaptive uses for ecosystem services

#### **Publications:**

#### White Paper:

1. Steve Elliot, Sally Duncan, Nigel Malone (2014). *The New Nature of Business: How Business Pioneers Support Biodiversity and Ecosystem Services*.

#### **Presentations:**

- Dr. Guy Ziv of Leeds University presented on NNoB report as invited speaker in UFZ ESCALTE colloquium 25/3/2014, and contributed as NNoB representative to review of B@B Platform "Natural Capital Accounting" workstream NCA Decision-matrix tool
   (<u>http://ec.europa.eu/environment/biodiversity/business/workstreams/Workstream1-Natural-Capital-Accounting/Outputs-to-date.html</u>)
- 2. Mary Klein, CEO of NatureServ presented details of the Pursuit's activities at the ACES conference on December 11, 2014.
- 3. Steve Elliot presented on the NNoB report to an international business forum in Sydney on October 8, 2014.

#### Follow-on funding/proposals submitted:

1. Addition of \$50,000 from University of Sydney and \$5,000 from Oregon State University to assist in web/white paper development and case studies respectively.

#### Website:

1. The New Nature of Business http://www.newnatureofbusiness.org/

In the first nine months since publication, the New Nature of Business report has demonstrated impact on building international awareness of business and biodiversity through the more than 2,950 downloads of the report in 80 countries across six continents: Africa, Asia, Australia, Europe, North America and South America. Approximately 75% of websites making referrals to the NNoB website were businesses (ie, websites with domain name category '.com' or '.co'). Universities comprised 10% of referrals and other organizations (eg advocacy groups) 15% (source: Google Analytics).

These metrics highlight the level of business interest in Biodiversity and Ecosystems Services. The metrics are also a strong indication of the team's capabilities to engage with business and to build business awareness of this global priority issue.

#### New collaborations:

 Addition of PS Narayan, Director of Sustainability for Wipro, Inc, the largest IT company in India. He will bring connections and potential for collaboration to the national and international business community in India.

#### Engagement with knowledge users/potential impacts:

- Joe Starinchak of US Fish & Wildlife is advocating a Connecting the Dots collective that brings together the SESYNC Pursuit and multiple other business, academic and government ventures that are based on the power of the marketplace to make change under current governance and political circumstances.
- 2. Josiane Bonneau of Wildlife Habitat Council is investigating active engagement of their hundreds of members in contributing stories of progress to the NNoB catalogue and community of practice.
- 3. See also above Analytics on downloads of the New Nature of Business report (point 1 above) demonstrating business impact.
- 4. Invited presentation for Singapore's National Environment Agency to explore collaboration between business, government and society to address challenges to the environment, biodiversity and ecosystems (April 2013 see attached).

#### Publicity:

- 1. January 13, 2015, story in the Guardian, UK: <u>http://www.theguardian.com/sustainable-business/2015/jan/13/environment-natural-capital-accounting-animal-nature-business</u>
- OSU alumni coverage September
   2014 <u>http://www.osualum.com/s/359/file\_lib/1/50/13\_Leading\_Edge\_201408\_6354423302607</u> 76015.pdf
- 3. In Australia, the NNoB report received national coverage in daily newspapers.

Monitor Human–Nature Links; PIs: Heather Tallis, Belinda Reyeres, and Sandy Andelman Project Title: Monitoring the direct links between ecosystem services and people

#### **Publications:**

#### In review:

- 1. Selomane O., B. Reyers, R. Biggs, H. Tallis, S. Polasky. Towards integrated social-ecological sustainability indicators: exploring the contribution and gaps in existing global data. In Review in *Ecological Economics*.
- 2. Hamann, M., Biggs, R., Reyers, B. An approach to mapping and characterizing social-ecological systems based on ecosystem service bundles in South Africa. In Review. *Global Environmental Change*.

#### Practitioner publications:

- Assessing ecosystem service change & its impacts on human wellbeing: A national pilot of indicator approaches and data 2014. B. Reyers, J. Nel, P. O'Farrell, O. Selomane, J. Smith & T. Yapi. CSIR/NRE/ECOS/IR/2014/0016/B
- 2. The *Nature* Conservancy's Conservation Business Planning Guidance. We (H. Tallis, Y. Masuda, J. Musengezi) have submitted recommended changes for including guidance on measuring conservation impacts on people for the standard work of the organization. These are in review and a final updated Guidance document will be released this summer.

#### **Presentations:**

- H. Tallis: What's nature got to do with us? Defining, measuring and acting on the role of nature in human life. Faculty Seminar, Environmental Studies Department, University of California, Santa Cruz. 20 May 2013, Santa Cruz.
- 2. H. Tallis: The Human Dimensions Program and Quantifying Nature's Impacts on People. July 2013. The Nature Conservancy's Global Board and Science Council.
- 3. H. Tallis, S. Polasky: Briefing of the Restore Council Executive Director on measuring ecosystem services in the Gulf of Mexico. 23 Sept 2013. New Orleans.
- 4. H. Tallis: Changing People's Minds: Social monitoring to create evidence of conservation impacts on people. The Nature Conservancy's Annual Trustees Meeting, 9 Oct 2013. Washington, D.C.
- B. Reyers: Capacity Building Workshop for Undertaking Ecosystem Assessments. 3rd 6th February 2014. Kievits Kroon Estate, Pretoria, South AfricaA Sub-Global Assessment Network workshop co-convened by UNEP-WCMC, & The Council for Scientific and Industrial Research (CSIR), with the support of the Norwegian Environment Agency and the Stockholm Resilience Centre.

#### Students and postdocs in the project:

- 1. Odirilwe Selomane (PhD. Student, South African National) participated in one of our working group meetings. He is now leading a paper as a product of that meeting.
- 2. Maike Hamann (PhD. Student, South African national) is leading another paper as a product of a working group meeting.
- 3. Daniel Karp (post-doc, US national) is leading a paper as a product of a working group meeting and connections to previous work.

#### Proposals for follow on research funding:

1. COMPASS has contributed matching funds from a foundation grant to our current working group funds to facilitate our engagement with the US Department of Commerce.

- 2. H. Tallis has submitted a \$5M proposal to a private donor through TNC, partially focused on developing a framework for measuring the impact of water funds on upper watershed beneficiaries in Latin America, and on establishing an upper-watershed social monitoring program in one water fund in Colombia.
- 3. Funds awarded to H. Tallis through NSF are being used in part to apply lessons from our working group to actual social monitoring in Kenya.

#### Evaluating Trade-offs; PIs: Lydia Olander and Dean Urban

Project Title: Incorporating Values and Assessing Social and Environmental Trade-offs in Managing for Ecosystem Services

#### **Publications:**

 National Ecosystem Services Partnership. 2014. Federal Resource Management and Ecosystem Services Guidebook. Durham: National Ecosystem Services Partnership, Duke University. <u>https://nespguidebook.com/</u>

Papers in progress (both as white papers and also as submissions to Ecosystem Services):

- L. Olander, Urban, D., K. J. Bagstad, J. Boyd, G. Buckley, C. F. Casey, P. Comer, J. Cushing, R. Deal, M. Effron, J. Fay, K. Halsey, D. Harrison-Atlas, D. Hellerstein, T. Holmes, S. Howell, C. Ihlo, R. J. Johnston, J. Kagan, K. Locklier, L. Maguire, E. Maillett, T. McPhearson, R. Moore, A. Neale, M. Papenfus, T. Patterson, M. Plummer, P. Ringold, M. Robertson, D. Saah, B. Sherrouse, S. Sifleet, D. Theobald, H. Townsend, T. Vegh, S. Vickerman, L. Wainger, P. Wiley, and R. Winthrop. 2015. A Standard Framework for Ecosystem Services Assessments.
- Urban, D., L. Olander, K. J. Bagstad, P. Comer, T. Holmes, J. Kagan, W. Lehman, J. Loomis, T. McPhearson, A. Neale, L. Patterson, L. Richarson, D. Saah, S. Sifleet, K. Stockmann, and R. Winthrop. 2015. Data and Modeling Infrastructure Needs for Applying an Ecosystem Services Approach to Planning and Management Nation-wide.

#### **Presentations:**

Building the Data Infrastructure to Support Nation-wide Ecosystem Services Assessments
 A Community on Ecosystem Services Conference, December 11, 2015.

 Presented by: Dean Urban (Duke University), Jimmy Kagan (Institute for Natural Resources,
 Oregon State University and Portland State University), Anne Neale (EPA), Robert J. Johnston
 (Clark University), and Lynn Maguire (Duke University)

#### FRMES Data, Software, and Websites:

The Federal Resource Management and Ecosystem Services Guidebook is the culmination of all efforts on this project. It will be an online-only resource, available beginning December 8, 2014. We will provide the URL once the site is live.

#### **FRMES Outreach Events:**

1. September 23-26, 2013 (Washington D.C.)

The FRMES Core Team hosted a series of meetings providing updates on the project's status to a number of federal agency partners.

- July 21, 2014 (Washington D.C.) Meeting with existing agency partners to discuss next steps in federal agency implementation of ecosystem services approaches post the guidebook's completion (led by the FRMES Core Team)
- 3. July 22, 2014 (Washington D.C.) Open meeting hosted by the FRMES Core Team to staff from federal agencies, NGO's, consulting firms, and other organizations to introduce the FRMES Guidebook
- 4. July 22, 2014 (Washington D.C.) Meeting with members of the Executive Office of the President to discuss the FRMES Guidebook (facilitated by Lydia Olander, Dean Urban, Sally Collins, and Lynn Scarlett)
- October 1, 2014 (Washington D.C.) Presentations on the FRMES Guidebook by Lydia Olander and Sally Collins to U.S. Forest Service Federal Advisory Committee Act Committee and to U.S. Forest Service Leadership (Deputy and Assistant Deputy Chiefs)
- November 20, 2014 (Remote webinar) Presentation on the FRMES Guidebook during the U.S. Forest Service's NEPA Café webinar (hosted by Lydia Olander and Dean Urban)
- December 12, 2014 (ACES Conference)
   Continuation of conversation with existing agency partners (from July 21) to discuss next steps in implementation of ecosystem services approaches within federal agencies

#### **Additional Information:**

The FRMES project has also hosted a Community of Practice, bringing together experts and practitioners from various federal agencies, academic institutions, and NGOs. The Community of Practice held a series of webinars beginning in January 2013 (ten total to date) to discuss recent advances in ecosystem services assessments and the development of a consistent assessment framework. Many attendees of the NCEAS and SESYNC workshops also contributed to the Community of Practice.

#### MPA Social-Ecological Systems; PIs: Helen Fox and Robert Pomeroy

Project Title: "Solving the Mystery of Marine Protected Area Performance: Linking Governance, Conservation, Ecosystem Services and Human Well Being"

#### **Publications:**

#### In prep:

 Mascia, M. B. et al. (other authors & order to be determined). Analyzing Conservation Impacts: Evaluation, Theory, and Marine Protected Areas (MPAs) (in prep). Target journal: Annals of the New York Academy of Sciences: The Year in Ecology and Conservation Biology (2014).

#### **Presentations:**

1. Solving the mystery of Marine Protected Area performance: linking governance, conservation, ecosystem services, and human well-being. World Parks Congress, Sydney, Australia, November 12-19, 2014.

- 2. Solving the mystery of Marine Protected Area performance: linking governance, conservation, ecosystem services, and human well-being. Gulf Caribbean Fisheries Institute conference, Barbados, November 3-7, 2014.
- 3. ICCB (July 2013) Solving the mystery of marine protected area (MPA) performance: linking governance, conservation, ecosystem services, and human well being
- 4. International Marine Conservation Congress (August 2014)
- 5. Gulf Caribbean Fisheries Institute conference (November 2014)
- 6. World Parks Congress (November 2014)

#### Students involved with project and/or trained:

- 1. Genevieve Allen (UMD): Summer intern Data, software, tools, and websites produced from synthesis efforts:
- 2. Collaboration with Luc Hoffmann Institute David Gill.

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

- This project was presented to a variety of audiences over the past few months. In addition to those mentioned above, presentations were given to the Luc Hoffmann Institute Board (Gland, Switzerland), staff at the World Conservation Monitoring Centre (Cambridge, UK), World Wildlife Fund US (Washington DC) and at an in-house post-doctoral seminar at SESYNC.
- The project was also presented at a side-event at the Convention on Biological Diversity (12th COP) in October in Pyeongchang, Republic of Korea. Audiences for these presentations included conservation practitioners, NGOs, high-level government representatives as well as academics and other researchers.

#### Database or tools developed:

We are creating new datasets (e.g. METT & NOAA management checklist are being merged to produce more robust dataset re: MPA governance and management; and ditto for AGRRA & Lester et al. datasets re: ecological outcomes).

#### New collaborations:

 Partnership/collaboration with the IUCN WCPA/SSC Joint Task Force on Biodiversity and Protected Areas via Stephen Woodley (<u>http://www.iucn.org/about/work/programmes/gpap\_home/gpap\_biodiversity/gpap\_wcpabiod</u> <u>iv/gpap\_pabiodiv/</u>) Our WG is the marine branch of their efforts, and Stephen has significantly supported dissemination of our results (e.g. he supported David's trip to WPC & costs of Megan's trip to the COP beyond the ticket, for which we are VERY grateful to SESYNC).

# Biodiversity, ESS & Sustainable Mitigation Scenarios; PIs: George Hurtt and James Edmonds

Project Title: "Integrating Biodiversity, Ecosystem Services and Sustainability Mitigation Scenarios"

#### **Publications:**

In review:

- Y. Le Page, G. Hurtt, A.M. Thomson, K. Calvin, P. Kyle, S. Waldhorf, L. Clarke, K. Dolan, J. Edmonds, P. Patel, M. Wise. Impacts of climate mitigation policies on food prices and regional food production in an integrated assessment model. *Climatic Change*. In rev.
- 2. Jantz, S., T. Brooks, Q. Huang, G. Hurtt, R. Moore, J. Noel. Future habitat loss and extinctions in biodiversity hotspots under four climate change mitigation scenarios. *Conservation Biology*. In rev.

#### In prep:

- 3. Chini, L., G. Hurtt, S. Jantz, T. Brooks, L. Clarke, S. Waldhoff. Protecting Future Biodiversity via Re-allocation of Future Land-use Change Patterns. In prep.
- 4. Hurtt, G. et al. Sustainable Global Climate Mitigation Scenarios. In prep.

#### Presentations:

1. Chini, L., G. Hurtt, S. Jantz, T. Brooks, L. Clarke, S. Waldhoff (2013) Protecting Future Biodiversity via Re-allocation of Future Land-use Change Patterns. AGU Fall Meeting Oral Presentation.

# THEME 5: Water, People & Ecosystems

#### Socio-Hydrology; PIs: Tara Troy and Murugesu Sivapalan

Project Title: Towards socio-hydrologic synthesis: modeling the co-evolutionary dynamics of coupled human, water and ecological systems

#### **Publications:**

#### Published:

1. Lin, X., Q. Dang, and M. Konar, (2014), A network analysis of food flows within the USA, Environmental Science & Technology, Vol 48, Issue 10, pp. 5439-5447, doi: 10.1021/es500471d.

#### Under Review:

- 2. Konar, M., T. Evans, M. Levy, C. Scott, M. Sivapalan, and T. Troy (In Review), A sociohydrology blueprint to advance the freshwater planetary boundary.
- 3. Marston, L., T. Troy, X. Cai and M. Konar, (In Review), Virtual groundwater transfers from overexploited aquifers in the United States.

#### Accepted:

4. Dang, Q., X. Lin and M. Konar, Agricultural virtual water flows within the USA, Forthcoming in Water Resources Research.

#### Submitted:

- 5. van Emmerik, T and Li, Z and Sivapalan, M and Kandasamy, J and Pande, S and Chanan, A and Savenije, HHG (). Conceptual socio-hydrologic model of the "pendulum swing" between agriculture development and environmental health in the Murrumbidgee river basin, Australia. Hydrology and Earth System Sciences
- 6. Liu, D and Tian, F and Lin, M and Sivapalan, M (). A coupled modeling framework for sociohydrology co-evolution: case study of Tarim River Basin, Western China. Hydrology and Earth System Sciences

7. Elshafei, Y and Sivapalan, M and Tonts, M and Hipsey, ML (). A prototype framework for a sociohydrology model: identification of key feedback loops with application to two Australian case studies. Hydrology and Earth System Sciences.

#### In prep:

- 8. Dang, Q., J. Reimer, G. Di Baldassarre, R. Zheng, X. Lin, and M. Konar (in preparation), A theoretical model of water and trade.
- 9. Tara Troy et al. HESS Synthesis paper (in preparation)
- 10. Megan Konar et al. (2015) Planetary boundaries paper Earth System Dynamics
- 11. Tara Troy 2015 Water Resources Research, Socio-hydrology Debates paper
- 12. M. Sivapalan (2015) Water Resources Research Socio-hydrology Debates paper
- 13. M. Sivapalan and G. Bloeschl (2015) Water Resources Research 50th Anniversary Special Issue (in preparation)
- 14. M. Sivapalan et al. (2015/2016) Socio-hydrology. Monograph based on HESS special issue -Cambridge University Press
- 15. Yasmina Elshafei, M. Sivapalan et al. (2015) A model of the socio-hydrologic dynamics in a semi-arid catchment: Isolating feedbacks in the coupled human-hydrology system. To be submitted to Water Resources Research
- 16. Xi Chen, Dingbao Wang et al. (2015) Understanding Socio-Hydrology System in the Kissimmee River Basin (paper in preparation, WRR?)
- 17. Roobavannan Mahendran, Jaya Kandasamy et al. (2015). Use of a coupled socio-hydrology model to assess future water management options in the Murrumbidgee River Basin (paper in preparation, WRR?)
- 18. Ye Liu, Fuqiang Tian et al. (2015). Use of a coupled socio-hydrology model to assess future water management options in the Tarim River Basin, China (paper in preparation, WRR?)

#### **Presentations:**

- 1. Linda Kuil, Morgan Levy, Mitch Pavao-Zuckerman, Gopal Penny, Christopher Scott, Veena Srinivasan, Sally Thompson, and Tara Troy, "Syndromes of the global water crisis exploring the emergent dynamics through socio-hydrological modeling," European Geosciences Union General Assembly 2014.
- 2. Megan Konar et al. AGU Fall Meeting December 2014 Water footprint assessment
- 3. Tara Troy et al. AGU Fall Meeting December 2014 Socio-hydrology and Pante Rhei
- 4. Guiliano Di Baldassarre, Tara Troy, Veena Srinivasan et al. IUGG General Assembly 2015 Sociohydrologic Modeling
- 5. Sivapalan and Bloschl AGU Fall Meeting, WRR 50th Anniversary Session
- 6. Sivapalan et al. AGU Fall Meeting, Coupled Human-Nature Systems Session
- 7. Konar 2014 AGU Fall Meeting & 2014 Water for Food Conference, Agricultural virtual water flows in the USA.
- 8. Konar 2014 Water for Food Conference, Impacts of crop insurance on crop water use.
- 9. Konar 2014 EGU Annual Meeting, A theoretical model of water and trade.
- 10. Konar 2014 EGU Annual Meeting, Virtual water trade and development in Africa.

#### Student involvement and/or training:

- 1. Xi Chen University of Central Florida
- 2. Yasmina Elshafei University of Western Australia

- 3. Roobavannan Mahendran University of Technology Sydney
- 4. Ye Liu Tsinghua University
- 5. Morgan Levy University of California Berkeley
- 6. Qian Dang University of Illinois
- 7. Xiawen Lin University of Illinois

#### Grants and proposals prepared/awarded:

- 1. Konar, Troy, and Deryugina submitted to NSF Infrastructure Management under Extreme Events 2014 call
- 2. Konar and Deryugina submitted to NSF Environmental Sustainability 2014 call
- 3. Konar submitted to NSF Hydrology 2014 call

#### Synthesis Outcomes:

- 1. Development of place-based coupled socio-hydrologic models (Tarim, Murrumbidgee, Toolibin, Kissimmee)
- 2. Development and implementation of the notion of "community sensitivity"
- 3. Development of a more generic model framework (Morgan Levy et al.?)

#### Future Projects (if SESYNC project is continued):

- 1. Likely (future) synthesis of these two approaches (generic vs specific)
- 2. Support towards the publication of the Synthesis Book (Cambridge University Press)
- 3. Development of a Global Socio-Hydrologic Model (from Megan's Planetary Boundaries paper)

#### Impact:

SESYNC project has helped to:

- 1. bring people together
- 2. make progress on development of models
- 3. bring about a synthesis

As a result of SESYNC funding socio-hydrology and socio-hydrologic modeling have gained acceptance in the community, as indicated by the invitation to contribute to Socio-hydrology Debates in WRR, the forthcoming special issue in WRR on Socio-hydrology and invitation to convene special session at IUGG and AGU.

#### **New Collaborations:**

Megan Konar is now collaborating with Jeff Reimer, which would not have been possible without SESYNC.

#### Resilience & Governance; PIs: Barbara Cosens and Lance Gunderson Project Title: Social-ecological system resilience, climate change and adaptive water governance

#### **Publications:**

In press:

- [JOURNAL ARTICLE] Cosens, B and Gunderson, L and Allen, C and Benson, Melinda H (2014). Identifying Legal, Ecological, and governance obstacles and opportunities for adapting to climate change. Sustainability 6, no. 4: 2338-2356 URL: <u>http://www.mdpi.com/2071-1050/6/4/2338</u>
- 2. **[BOOK]** Springer has accepted the proposal, finalize agreement Feb 2015. Cosens, B. and Gunderson, L. (editors), Practical Panarchy: Linking Law, Resilience and Adaptive Water Governance of Regional Scale Social Ecological Systems, Springer

#### Forthcoming February 2015:

- Cosens, B and Gunderson, L and Chaffin, B (2014 Forthcoming). The Adaptive Water Governance Project: Assessing Law, Resilience and Governance in Regional Socio-Ecological Water Systems Facing a Changing Climate. Idaho Law Review, Natural Resources and Environmental Law Edition.
- 4. Craig Anthony (Tony) Arnold, Olivia O. Green, Daniel Decaro, Alexandra Chase and Jennifer-Grace Ewa. Institutional Change and Social-Ecological Resilience: The Anacostia River Watershed. *Idaho Law Review, Natural Resources and Environmental Law Edition.*
- 5. Barbara Cosens, Alexander Fremier, Jan Boll. Governance and Ecosystem Services as Bridging Concepts in Social-Ecological Systems: The Columbia River Basin. *Idaho Law Review, Natural Resources and Environmental Law Edition.*
- 6. Lance Gunderson, Ahjond Garmestani, Keith W. Rizzardi, J.B. Ruhl. Adaptive Capacity for Changing Climate in the Everglades Social Ecological System. *Idaho Law Review, Natural Resources and Environmental Law Edition.*
- 7. Brian Chaffin, Robin Craig and Hannah Gosnell. Resilience, Adaptation, and Transformation in the Klamath River Basin Social-Ecological System. *Idaho Law Review, Natural Resources and Environmental Law Edition.*
- 8. Melinda Harm Benson, Dagmar Llewellyn, Ryan Morrison and Mark Stone. Crossing Thresholds in the Middle Rio Grande River. *Idaho Law Review, Natural Resources and Environmental Law Edition.*
- 9. Hannah Birge, Craig R Allen, Robin Kundis Craig, Ahjond S. Garmestani, Joseph A. Hamm, Christina Babbitt, Kristine Nemec, and Edella Schlager. Social-Ecological Resilience and Law in the Platte River Basin Platte River. *Idaho Law Review, Natural Resources and Environmental Law Edition.*

#### Submitted:

- Dec 2014. Cosens, B. L. Gunderson and B. Chaffin. Assessing Law, Resilience and Governance in Basin Scale Water Systems Facing Changing Climate: The Adaptive Water Governance Project International Environmental Law Committee Newsletter.
- 11. Dec 2014. Chaffin, B. and L. Gunderson. In review. Emergence, Institutionalization and Renewal: Rhythms of Adaptive Governance in Complex Social-Ecological Systems. *Journal Environmental Management,*

#### White Paper [published]:

 Available. Bankes, N. and Cosens, B. Protocols for Adaptive Water Governance: The Future of the Columbia River Treaty, October 21, 2014, research project for the Program on Water Issues, Munk School of Global Affairs, University of Toronto, http://powi.ca/wpcontent/uploads/2014/10/Protocols-for-Adaptive-Water-Governance-Final-October-14-2014.pdf.

#### Summary of White Paper [published]:

13. Bankes, N. and Cosens B. Columbia River Treaty Options: Protocols for Transboundary Adaptive Management Examined (condensed report on Bankes and Cosens 2014) 129 The Water Report, Nov. 15, 2014.

#### Book Chapter, forthcoming:

14. Forthcoming. Barbara Cosens, Alexander Fremier, Nigel Bankes and John Abatzoglou, The Columbia River Treaty and the dynamics of transboundary water negotiations in a changing environment: How might climate change alter the game? in Kathleen Miller, Alan Hamlet, Douglas Kenney and Kelly Redmond (editors), Western Water Policy and Planning in a Variable and Changing Climate (Taylor and Francis).

#### **Presentations:**

- Session, Cosens, A. Fremier, L. Gunderson, C. Allen, H. Gosnell, Robin Craig, Olivia Odom Green, B. Chaffin, Social-Ecological Resilience, Climate Change and Adaptive Water Governance of Regional Scale Water Systems in the United States. Resilience 2014: Resilience and Development; Mobilizing for Transformation. May 4-8, 2014. Montpellier, France.
- 2. Brian Chaffin. Rebuilding Windows of Opportunity: Adaptive governance and creative disturbance in the Klamath Basin, USA Resilience 2014, Resilience and Development; Mobilizing for Transformation. May 4-8, 2014. Montpellier, France.
- Adriana Keating (IIASA), Lance Gunderson (Emory University), Nils Ferrand (UMR G-EAU), Frédéric Grelot (UMR G-EAU), Elsa Leteurtre (LISODE), Mathieu Dionnet (LISODE Flood management and Watershed governance. Off-site sessions. Beziers, France. 5 May 2014 Organizers). Resilience 2014, Resilience and Development; Mobilizing for Transformation. May 4-8, 2014. Montpellier, France.
- 4. Benson, M.H. and B. Cosens. Resilience in water governance: building adaptive capacity within social-ecological systems facing climate change. Transformational Solutions for Water in the West Workshop. Sandia National Laboratories. Albuquerque, New Mexico 5 September 2013.
- Benson, M.H., Morrison, R, Stone, M., Llewellyn, D., Cosens, B., Gunderson, L., Allen C. Adaptive Governance and Social-Ecological System Resilience in New Mexico's Rio Grande Valley, Association of Environmental Studies as Sciences Annual Meeting Pace University, New York, New York June 11-14, 2014.
- 6. Bankes, N. and Cosens, B. Protocols for Adaptive Water Governance: The Future of the Columbia River Treaty, PNWER Summit, July 2014, Whistler, BC, Canada.
- 7. Cosens, B. and Gunderson, L., Adaptive Governance in the Headwaters, MTNCLIM 2014 Conference, Midway, Utah Sept 17, 2014 [*Presentation/linkage to AWG research*]
- 8. Cosens, B. Wilderness and Resilience: Remaining Unimpaired and Untrammeled in the Anthropocene, University of Utah College of Law Wilderness Act at 50 and the Mountain West, Salt Lake City, Utah, September 26, 2014. [*Presentation/linkage to AWG research*]
- 9. Gosnell, H. Adaptive Governance Workshop, World Protected Areas, IUCN Proposal [*Presentation/linkage to AWG research*]
- Practical Panarchy; Assessing Adaptive Capacity of Regional Water Systems in the United States to Changing Climate. Lance Gunderson, University of Kentucky, Dept Geography Seminar Series (March 2015).
- 11. Assessing Resilience and Governance in Regional Scale Water Basins Facing Climate Change, Climate @Emory seminar series, Spring 2015 Semester.

12. Abstract Accepted. The Adaptive Water Governance Project: Assessing Law, Resilience, and Governance in River Basin Social-Ecological Systems Facing a Changing Climate. Association of American Geographers Annual Meeting (April 2015).

#### Proposals submitted for follow-on funding:

 NSF Post Doctoral Fellowship NSFTransformative Environmental Governance: Re-engineering U.S. Rivers for social-ecological resilience. NSF SBE Postdoctoral Research Fellowship (SPRF) Proposal. Brian Chaffin (PI); Barb Cosens (Co-PI); Jan Boll (Co-PI); University of Idaho (Institution).

#### Student training/involvement:

- Participant and Ph.D. student Brian Chaffin completed his dissertation. Through connections formed in the AWG Project, he is currently a National Academies-NRC Postdoctoral Associate at the National Risk Management Research Laboratory of the United States Environmental Protection Agency in Cincinnati, Ohio.
- 2. Ph.D. student Shana Hirsch is part of the new Water Resources IGERT program at the University of Idaho and will be joining the AWG group for their last workshop. Co-chair Cosens is a participating faculty in the IGERT and will be linking the AWG Project to IGERT research.

#### **Resulting collaborations:**

- Australia: Co-chair Barbara Cosens will spend January 15 April 15, 2015, at the ANZSOG-Goyder Institute, Flinders University, South Australia doing research to apply the results of the AWG Project to the Lake Eyre Basin in Australia. Her proposal to the Institute was accepted following award of the SESYNC AWG pursuit.
- 2. IUCN: Co-chair Barbara Cosens and participants Hannah Gosnell and Brian Chaffin are members of the IUCN Resilience Thematic Group. With Hannah as lead, they developed input to a workshop on Adaptive Governance for the World Protected Areas IUCN conference in Sidney, Australia in November, 2015. Hannah presented at the workshop. The focus was initially on obtaining feedback on development of a workshop for managers. Gosnell and Cosens are continuing the collaboration with the Resilience Thematic Group to further develop the workshop approach. Cosens will test some of the concepts out in Australia and the SESYNC group has proposed a field trip to the Anacostia watershed at our final gathering to discuss the needs of watershed groups in this context.

#### EcoEngineering Resilience; PIs: Leroy Poff and John Matthews

Project Title: Climate change and water resources adaptation: Decision scaling and integrated ecoengineering resilience

#### Publications:

#### In prep:

1. In preparation: a consortium including the US Army Corps of Engineers, Deltares, the World Bank, U Mass, the Alliance for Global Water Adaptation, and others will be publishing a global guidance document in October 2015 based on the SESYNC methodology called Climate Risk Informed Decision Analysis for Robust water Management. This includes many of the SESYNC team members. John Matthews is the second author.

2. Deltares and the OECD are the lead author on a paper which should be submitted in early March on the economic adaptation pathways work from our theme. John Matthews is fourth author on this project.

#### Published:

- Pahl-Wostl, C., A. Arthington, J. Bogardi, S. Bunn, H. Hoff, L. Lebel, E. Nikitina, M.A. Palmer, L. Poff, K. Richards, M. Schluter, R. Schulze, A. St-Hilaire, R.E. Tharme, K. Tockner, and D. Tsegai (2013). Environmental flows and water governance: managing sustainable water uses. Current Opinion in Environmental Sustainability.
- 4. The US Army Corps of Engineers. Terms of reference (ToR). AGWA Guidebook for Climate Adaptation Planning and Evaluation Protocols for Enhancing Eco-hydrological Resilience in Water Management Infrastructure Decision-making.

#### Submitted:

 Poff, N.L., C. Brown, T.E. Grantham, J.H. Matthews, M.A. Palmer, C.M. Spence, R.L. Wilby, M. Haasnoot, G.F. Mendoza, K.C. Dominique, A. Baeza. Operationalizing sustainable water infrastructure management under climate change. Submitted to Nature Climate Change, February 2015.

#### **Presentations:**

- Matthews gave a talk to grad students / postdocs, Fort Collins CO, Colorado State October 2014 World Resources Institute, Washington DC - October 2014 UN Economic Commission of Europe's Transboundary Freshwater Adaptation workshop, Geneva, CHF - October 2014 UN Water and sustainable development goals, Zaragoza, Spain - January 2015 Swedish International Development Agency (Sida), Stockholm, Sweden - January 2015
- 2. Poff, N.L. Climate Change and Water Resources Adaptation: Decision-scaling and Integrated Eco-Engineering Resilience. Oral presentation at Stockholm World Water Week, Stockholm, Sweden, September 4, 2014.
- Poff, N.L. A way forward toward social-ecological sustainability? Eco-Engineering Decision-Scaling. Oral presentation at Murray Darling Basin Authority, Canberra, Australia, November 6, 2014.
- Grantham, T., N.L. Poff, C. Spence, J. Matthews, C. Brown, M. Palmer, A. Castro, and K. Hondula. Ecological decision scaling: a framework for incorporating ecological principles in water management decision-making. Oral presentation at AGU Annual Meeting. San Francisco, CA. December 16, 2014.
- 5. Spence, C., C.Brown, T. Grantham, and N.L. Poff. Incorporating ecological principles in water management decision making: Example application to flood management in Iowa. Poster presentation, 2nd Annual New England Graduate Student Water Symposium. Amherst, MA, September 12, 2014.
- Spence, C., T. Grantham, N.L. Poff, and C. Brown. Maximizing joint economic and ecological robustness in floodplain planning. World Environmental and Water Resources Conference. Floods, droughts, and ecosystems: Managing our resources despite growing demand and diminishing funds. Conference paper and oral presentation, Austin, TX. May 17-21, 2015.

#### Students involved with project and/or trained:

1. Caitlin Spence, PhD student, University of Massachusetts, Amherst

#### Press/media:

 World Water News by Ooska News. "Decision Scaling Approach Includes Ecosystems at Start of Project." 13 Oct 2014. <u>https://www.ooskanews.com/story/2014/10/decision-scaling-approachincludes-ecosystems-start-project\_162556</u>

#### Stories related to your project:

- 2. Palmer, Lisa. 2014. The next water cycle. News feature in Nature Climate Change 4:949-950
- Palmer, Lisa. 2014. Can Ecologists and Engineers Work Together to Harness Water For The Future? Wilson Center blog of the Environmental Change and Security Program, November 25, 2014. <u>http://www.newsecuritybeat.org/2014/11/ecologists-engineers-work-harness-waterfuture/</u>

#### Meetings, collaborations, and proposals for follow on funding developed from project: [NEW]

- Presentation / proposal: November 2014: the World Bank's strategic leadership team has asked us to prepare a concept note and proposal to develop a set of global freshwater resilience markers. This invitation came directly as a result of their attendance at our final SESYNC workshop last October. We should have word on the funding at the end of February.
- 2. **Proposal:** The International Development Resource Center (IDRC) is a Canadian government foreign aid agency. They also attended the October workshop and have asked if we can prepare a formal proposal to implement and test the economic-adaptation pathways work stream from our theme. We should hear a final answer this summer.
- 3. **Presentation / proposal:** The Mekong River Commission (MRC) saw a presentation by myself and two other members of our group of our SESYSNC outcomes in mid October in Geneva, Switzerland, at a UN transboundary waters adaptation meeting. They have asked if they could test several aspects of our work, and requested me to reach out directly to the US State Department about funding this work. We should know more details this summer. Other presenters in this series were Casey Brown (UMass) and Ad Jeuken (Deltares).
- 4. Proposal: The Rockefeller Foundation's new water program has asked us to prepare an ecoengineering decision scaling (EEDS) proposal, for submission 11 February, decision by 1 March. This will include the NASA's Goddard Space Science Center, US Army Corps of Engineers, World Bank, government of Vietnam, Colorado State, and USGS. We expect to have some stage 2 partners if we are invited to that stage that will include the cities of New York and Seattle.
- 5. **Funded:** a consortium of NGOs working on sustainability for the private sector (Climate Bonds Initiative, WRI, CDP, Ceres) have funded a project to use some of the outcomes in order to develop a set of formal global funding standards for so-called "climate bonds," which totaled some 38.5 billion USD in 2014. The draft standard will be released this week. The final standard should be published in October. John Matthews is the technical lead on this project.

# THEME 6: Learning to Integrate Across Natural & Social Sciences

EMBeRS; PIs: Deanna Pennington and Antje Danielson

Project Title: Understanding, Teaching, and Employing Model-Based Reasoning (MBR) in Socio-Environmental Synthesis (EMBeRS)
#### **Publications:**

#### Accepted:

- 1. Danielson, A. (2015). Supporting interdisciplinary graduate student training using model-based reasoning and systems mapping -- a case. *Journal of Environmental Studies and Sciences*. To appear.
- 2. Pennington, D. (2015a). Leading knowledge integration in interdisciplinary research and education. *Journal of Environmental Studies and Sciences*. To appear.
- 3. Vincent, S., Boone, C., Danielson, A., Gosselin, D., Parnell, R., & Pennington, D. (2015). Special Issue: Negotiating Boundaries: Effective Leadership of Intedisciplinary Environmental and Sustainability Programs. *Journal of Environmental Studies and Sciences*. To appear.

#### **Presentations:**

- 1. Danielson, A. (2014, June 13). *Using systems mapping and model-based reasoning in case simulation exercises*. Panel Presentation presented at the Association for Environmental Studies and Sciences (AESS), New York, NY.
- 2. Gosselin, D. (2014a, June 13). *Preparing students for the complexities of the workplace: Linking learning Outcomes, 21st Century Competencies and the Geosciences through InTeGrate*. Panel Presentation presented at the Association for Environmental Studies and Sciences (AESS), New York, NY.
- 3. Gosselin, D. (2014b, June 13). *Silo Busting for Dummies I & II: If we can do it so can you!!*. Panel Session presented at the Association for Environmental Studies and Sciences (AESS), New York, NY.
- 4. Pennington, D. (2015b, April 21). *Conceptualizing Complex Land Change Systems using Model-Based Reasoning*. Oral Presentation presented at the American Association of Geographers (AAG), Chicago, IL.
- Pennington, D., Aditomo, N., Bammer, G., Danielson, A., Gosselin, D., Habron, G., ... Vincent, S. (2014, August 7). *Knowledge Synthesis in Interdisciplinary Research Teams Using Model-Based Reasoning*. Poster Presentation presented at the Science of Team Science (SciTS), Austin, Texas.
- Pennington, D., Gosselin, D., Parnell, R., & Vincent, S. (2015, June 24). *Leadership in Interdisciplinary Research and Education*. Panel Presentation presented at the Association of Environmental Studies and Sciences, San Diego, CA.

#### Translational Ecology; PIs: Mark Brunson and Michelle Baker

Project Title: Translational ecology: A pedagogical framework to integrate natural and social sciences

#### **Presentations:**

- Mark Brunson. Aug. 15, 2014. Can Translational Ecology Help Scientists Think Beyond Shorter Words and Cooler Graphics? 99th annual meeting, Ecological Society of America, Sacramento, CA.
- 2. Baker, M.A. "Lost in translation: adventures in applied ecosystem ecology and combat science." Invited seminars at University of Wyoming and University of Utah.

#### Students involved with project and/or trained:

## Mark Brunson:

- 1. Twice since this pursuit was funded, I have taught a graduate class at Utah State University called Translational Ecology (ENVS 6410). Enrollments: 6 in Spring 2014, 9 in Spring 2015.
- 2. I also gave a virtual lecture to a graduate course in Sustainability and Socio-Environmental Systems at the University of Texas-El Paso on Jan 30, 2015.

# Teaching Climate Dynamics; PIs: Rachael Shwom and Rebecca Jordan

Project Title: The development of a social and ecological framework for understanding climate change mitigation and adaptation

# **Publications:**

# In prep:

1. Paper in draft; Shwom, R., McCright, A., Isenhour, C., Jordan, R. and Robinson, Jennifer M. "Enhancing Climate Science Literacy through the Social Sciences" to be submitted to *Frontiers in Ecology and Environment*.

#### **Presentations:**

- Rachael Shwom presented "Integrating Social Sciences to Increase Climate Literacy American Geophysical Union, December 16, 2014, San Francisco; Session on the Culture of Science "Teaching Climate Change Social Science and Its Practices"
- 2. Rebecca Jordan input a workshop session and has been accepted at Ecological Society of America 2015 entitled "Learning Across Natural and Social Sciences: Using a Social and Ecological Framework"
- 3. Rebecca Jordan will be guest lecturing in Deanna Pennington's class next week (they are modeling workshop ed pursuit)

#### Databases:

Coupled human climate system conceptual model completed and social scientific claims and how we know underlying model completed.

#### Student or postdoc training/participation in the project:

Rutgers graduate Student Amanda Sorensen has conducted research and presented at our SESYNC meetings.

#### Proposals for follow-on research funding:

 Jordan, Shwom PI and Co-investigators Shwom, Rachael, Gray, Steven et al. submitted to NSF for funding IND: Training 21st Century Investigators: Citizen Science, Social Science, and Model-Based Reasoning

# THEME 7: Biodiversity & Ecosystem Services

# Socioecology of Acacia; PIs: Christoph Kueffer and David Richardson

Project Title: Anticipatory governance and societal feedbacks in socio-environmental transitions: multicontinental

# **Publications:**

# Submitted:

- 1. Gaertner, M., Larson, B.M.H., Irlich, U.M., Holmes, P.M., Stafford, L. van Wilgen, B.W. & Richardson, D.M. Managing invasive species in cities: Lessons from Cape Town, South Africa. *Frontiers in Ecology and the Environment*, submitted.
- Kueffer, C., Kull, C. Non-native species and the human perception of nature [working title]. 2015. In: Hulme, P., Vilà, M., Ruiz, G. (eds). Impact of Biological Invasions on Ecosystem Services, Berlin: Springer, invited and submission in February 2015.

# In review:

 Vicente, JR, Alagador, D, Guerra, C, Alonso, JM, Kueffer, C., Vaz, AS, Fernandes, RF, Cabral, JA, Araújo, MB, Honrado, JP 2015. Effective and cost-efficient monitoring of biological invasions under global change: A model-based framework. *Journal of Applied Ecology*, invited and in review.

# **Presentations:**

- Gaertner, M, Kull, C. & Kueffer, C. 2014. Anticipatory governance and societal feedbacks in socio-environmental transitions: multicontinental acacia invasions as a model system. Wednesday, 3rd September 2014, 4-5pm. UFZ Halle and Leipzig and Magdeburg (by video).
- 2. Vicente, JR 2015. Applications of ecological models to assess biological invasions of forest ecosystems in a rapidly changing world. sDiv, Leipzig, February 18 2015.

# **Conference sessions:**

 Vicente, JR, Honrado, JP, Kueffer, C (session chairs). 2015. Multi-scale management of plant invasions and of their impacts on ecosystem services - from global anticipation to local governance. EEF 2015 - ECOLOGY AT INTERFACE, Rome, September 21-25 2015. <u>http://www.ecologyatinterface.eu/</u> (approved).

# Grant proposals/follow-on funding:

1. Vicente, JR (PI) et al. 2015. General Models of Invasions and Regime Shifts. FCT, Portugal (<u>https://www.fct.pt/</u>). c. 200k Euro, under review.

# New collaborations:

Ecosystem services and invasions. Leipzig, February 17 2015. Joint workshop between SESYNC project team, professorship of Aletta Bonn (<u>https://sites.google.com/site/alettabonn/home</u>), and the UFZ (Dr. Jennifer Hauck, <u>http://www.ufz.de/index.php?de=19117</u>).

# LU–BD–ES Trade-Offs; PIs: Ralf Seppelt, Peter Verburg, and Sandra Lavorel

Project Title: Effects of land use on the trade-off between biodiversity and provisioning ecosystem services

# Publications:

Not related to the LU-BD-ES projects but to the "land system synthesis studies" workshop by Erle Ellis and Peter Verburg, here I starting writing the following paper with Jack Liu: Seppelt, R., Manceur, A.M., Liu, J., Fenichel, E.P., Klotz, S., 2014. Synchronized peak-rate years of global resources use. Ecol. Soc. 19, 50. doi:10.5751/ES-07039-190450

# Students involved with project and/or trained:

- 1. Silvia Ceausu (iDiv)
- 2. Helen Philips (Univ Collage London)
- 3. Willem Verhagen (VU Amsterdam)
- 4. Katharina Gerstner (UFZ)

Which are funded by other projects (namely ESCALATE research school and iDiv) who benefit a lot from the work in the workshop and who provide great input.

# Proposals submitted for follow-on research:

Mostly on the cooperation with ESCALATE but also stimulated by the work in SESYNC we continue fostering Ph.D. student education in smaller synthesis workshops, i.e. bring together 5-10 Ph.D. student on a very specific project (like historical ecosystem services analysis based on an old textbook by Ellenberg, the last one). Based on this we now collaborated with Guy Ziv (also a participant in SESYNC workshops) and got the FAWKES projects running (Facilitated Workshops on Ecosystem Services), funded by Univ. Leeds 4 workshops for 2 synthesis groups.

# Urban Biodiversity & ESS; PIs: Myla Aronson and Charles Nilon

Project Title: Ecological and social linkages among biodiversity, ess, and environmental policy and management in the world's cities

# Students involved with project and/or trained:

- 1. Graduate Student: Lauren Frazee, Ecology and Evolution Graduate Program, Rutgers University.
- 2. Ken Yocom, course materials for Ecological Design and Planning, University of Washington, Seattle. Spring 2014.
- 3. Charles Nilon, course materials for Urban Wildlife Conservation, University of Missouri, Columbia. Spring 2014.

# Data, software, tools, and websites produced from synthesis efforts:

We have developed a database of 125 environmental and sustainability plans/policies from 40 cities. From each plan we have synthesized the data used to develop each plan (city scale, species, and habitats), biodiversity and ecosystem service goals, objectives and targets.

#### Stories related to your synthesis efforts:

We have started our data analysis. We have found that cities appear to include either ecosystem services or biodiversity, very few plans address both. Many plans discuss goals for increasing biodiversity, education, and stewardship as well as goals for reducing the urban heat island, increasing air quality and carbon sequestration. However, very few cities have specific quantitative targets to measure these goals. Additionally, cities that have data at the city scale for species or habitats likely have quantitative targets for particular habitats or species.

# Human Decisions & ESS; PIs: Marco Janssen & Maja Schluter

Project Title: Synthesis of micro-scale human decision making to mitigate risks to ecosystem services

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

Summer school on "How to model human decision making in social-ecological agent-based models": <u>http://www.ufz.de/index.php?en=33352</u>

#### Students involved with project and/or trained:

- 1. Nathan Rollins (ASU)
- 2. Gunnar Dresler (UFZ)
- 3. Kirill Orach (Stockholm University)

#### Data, software, tools, and websites produced from synthesis efforts:

1. <u>http://www.ufz.de/index.php?en=33352</u>

# A Restoration Synthesis; PIs: David Moreno Mateos and Holly Jones

Project Title: Feedbacks between biodiversity and ecosystem functions and services during the recovery process of restored ecosystems after anthropogenic disturbance

#### **Presentations:**

- Meta-analysis of Studies Evaluating the Impact of Forest Restoration on Climate Change Mitigation and Biodiversity. Paula Meli, Karen D. Holl, José M. Rey Benayas and it was made to the Forest Landscape Restoration group at the International Union for the Conservation of Nature. Washington D.C. November 2014.
- 2. Slow recovery of aquatic ecosystems from eutrophication. Michelle McCrackin Joint Aquatic Sciences Meeting (Association for the Sciences of Limnology and Oceanography, Society of Wetland Scientists, and the Society of Freshwater Scientists). May 2014.
- 3. The potential for ecosystem restoration in the Anthropocene. H.P. Jones. I was one of three invited speakers for a panel about Conservation in the Anthropocene at University of Massachussets Boston. December 12, 2014.

4. Ecosystem recovery following small versus large scale agriculture. Ryan Blackburn\* and Holly Jones. NIU Research and Artistry Day. April 2014.

#### Proposals submitted for follow-on research:

- 1. International Union for the Conservation of Nature, Meta-analysis of Studies Evaluating the Outcome of Forest Restoration. Karen Holl, Paula Meli, Jose Rey Benayas. 15,000 €. Funded.
- European Research Council Starting Grants. Restoring tropical forest complexity after pre-Columbian anthropogenic disturbances. David Moreno Mateos, Daniel Montoya, and others. 1,500,000 €. Submitted.

#### Students involved with project and/or trained:

- 1. Paula Meli. PhD thesis. Restauración de la biodiversidad y los servicios de los ecosistemas ribereños y otros humedales. Meta-análisis global y evaluación de especies útiles en el trópico húmedo mexicano. Universidad de Alcala. Spain.
- 2. Brownen Stanford. University of California, Santa Cruz. Graduate student.

#### Data, software, tools, and websites produced from synthesis efforts:

Meta-analytical database on ecosystem recovery from 486 studies including 5,060 response variables.

#### Stories related to your synthesis efforts:

I know that the whole team is extremely excited about this opportunity created by SESYNC, iDiv, and UFZ to increase our understanding of the relationships between biodiversity adn ecosystem services during the process of ecosystem recovery at a global scale. Preliminary results are showing completely different recovery patterns for biodiversity and functions related to services according to the kind of habitat and of disturbance that degraded the ecosystem. For example, it seems that aquatic ecosystems, contrary to our predictions, need longer to recover than terrestrial systems. And that this process may take more than 100 years – that is where the data usually reaches.

Thanks to the multidisciplinarity of the team, we are applying economic metrics, such as elasticity, to estimate the ratio of functional recovery to biodiversity recovery, and detect potential feedbacks between biodiversity and biogeochemical function over time. The presence of an economist has also been essential to deal with some mathematical issues during data analysis.

# Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

A collaboration with the International Union for the Protection of Nature to focus on forest recovery is already ongoing using our data base. We are preparing a publication specifically oriented to managers of restoration programs or strategies, where our core messages are clearly stated.

#### Comments:

Technological support for videoconferences and data sharing was particularly useful. We expect to get to the outreach part of the project after our next meeting in Germany in May. We are all extremely happy with the support and efficiency of the whole SESYNC team in all possible senses.

# From Water To Land?; PIs: Seeta Sistla and Daniel Kramer

Project Title: Playing dominoes with tipping points? Exploring the linkages between anthropogenicallydriven shifts in marine and terrestrial biodiversity and ecosystem services in a rapidly globalizing coastal region within the Mesoamerica Biodiversity Hotspot

# **Presentations:**

- 1. Informal presentation to NOAA Climate & Global Change Fellows summer institute, July 2014 (Seeta Sistla, "Exploring the consequences of land use change on soil quality and microbial diversity in a tropical agroforestry system").
- 2. This project will also be discussed in an invited talk at ESA 2015 (Seeta Sistla, title TBD).

# Students involved with project and/or trained:

- 1. Nicholas Williams (PhD student, UCSB)
- 2. Adam Roddy (PhD student, UC Berkeley)

# Stories related to your synthesis efforts:

Our collaboration has forced team members to develop innovative ways to link disparate, but overlapping systems (social and natural, terrestrial and marine, micro and macro-scales). Our work is in progress, but we see this project yielding several papers: (1) A comparison of agrobiodiversity across three biodiversity metrics for the different regional land use types; (2) An exploration of the heterogeneous response in fishing/farming households to changes in market access within the context of fishery decline; (3) Modeling how land use change in the region affects soil/plant carbon pools; (4) A synthesis paper on the feedbacks between aquatic and terrestrial ecosystem services in rapidly globalizing coastal regions; (5) A white paper with local stakeholders on regional terrestrial and aquatic biodiversity changes following road expansion.

# Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

- 1. Our group will write a white paper in summer 2015 for the Pearl Lagoon Basin, NI.
- 2. In January, 2015 we had an interview about the project with Antonia Sohns.

# Comments:

Our group feels very fortunate to have been funded by SESYNC. Without the working group grant, the syntheses we are completing would not have been possible. We think our experience could be further improved if we were to have more interaction with SESYNC when we are meeting there - perhaps through giving a talk or a scheduled mixer with resident researchers.

# VENTURES

Experiment in Teaching; PIs: Alan Berkowitz and David Hawthorne Project Title: "Experiment in teaching the socio-environmental synthesis process"

# Carrie Solomon, Gallaudet University

- We offered the socio-environmental synthesis course for the second time (Spring 2014) as a general studies elective with approximately 20 students, and of which many had not yet declared their majors.
- We are preparing our module(s) for publication to TIEE and hopefully this will be submitted by February 2015.
- We were able to recommend to a staff member (Robert Sivage) to connect with SESYNC. He came to present at a STM (Science, Technology and Mathematics) department meeting about a research project where he was studying how lab space is utilized by visual learners before building/renovating current lab space. He installed many cameras in a mock-up space and two lab classes took place there. Robert was able to use the data to advise architects about where lab benches, sinks, and hoods should be located. We felt that this was a project that SESYNC would be interested in because it involved how people think and utilize space in the sciences to better learn which was an excellent collaboration between the natural and social sciences.
- We also communicated with several people about a new educational project that would involve cognition, visual learning, and large data sets, which was inspired by the call for proposals for the education component of SESYNC. There was an initial meeting at SESYNC that involved talking with Margaret, Jon, and Joseph. Joseph was particularly helpful who at UMD could be part of the project (e.g. Amitabh Varshney), and Carrie discussed the idea with two researchers at RIT who were cognitive psychologists (Poorna Kushalnagar, Jeff Pelz). We had support from SESYNC to go ahead and submit a proposal for doing some preliminary work but this never materialized due to heavy teaching and service responsibilities on the part of Carrie and Khadijat.
- Carrie was able to advise a fellow colleague about teaching students on how to use large data sets for a biology service course based on her experiences on teaching the socio-environmental synthesis course two times.
- Carrie submitted a preliminary NSF PIRE grant in October 2014 with Dr. Pat Glibert (UMCES) and other collaborators which involves studying several US estuaries and Hangzhou Bay in China. The educational component will heavily be based on the SESYNC teaching study work as different case study modules will be used by the different institutions in their courses about various environmental science issues. Carrie will lead this effort if the grant is funded.
- Reflecting back on the last year, I can see that the influence of SESYNC has been small (advice to colleagues) to large (thinking of larger future projects). I have been glad to be part of SESYNC, and thank you for this opportunity!

STEM Educ & State Policy; PIs: Cathy Middlecamp, Mel George, Judith Ramaley Project Title: "State policies to transform undergraduate STEM education in support of global sustainability"

# **Presentations:**

- 1. Mel George and Marlit Hayslett. Undergraduate STEM Education and Global Sustainability: The Roles and Importance of Education Policy. Atlanta Conference on Science and Innovation Policy. September 27, 2013.
- Judith Ramaley, Jay Labov, Cathy Middlecamp. STEM Education Policies and Policymaking: Pushing in the Same Direction. 2014 AAAS National Meeting, Chicago. February 15, 2014.

#### Grant proposals authors/planned:

- EAGER grant; National Science Foundation, \$194,926; 9/15/2012 9/14/2014. WIDER: EAGER: State Policy and Undergraduate STEM Education: Uncharted ground. Catherine Middlecamp, PI. Co-PI: David Hawthorne.
  - a. With funds from NSF (WIDER:EAGER), our 5 state teams held an additional meeting in 2012 hosted by the CSU Office of the Chancellor, Longbeach, CA.
- NSF, IUSE, submitted April 2014. State Policy, Global Sustainability, and Undergraduate STEM Education: A Road Less Traveled (\$1.67 million). PI: David Hawthorne; Co-PIs: Jay Labov, Cathy Middlecamp.

# IFRI-SES Research; PIs: Arun Agrawal and Pete Newton

Project Title: "International Forestry Resources and Institutions (IFRI) research on forest social ecological systems for actionable science"

#### **Publications:**

#### Papers in progress (IFRI):

- 1. "As a result of my participation at these meetings, I have been able to co-develop three new research papers that uses IFRI data to test new ideas about the institutional conditions under which inequality outcomes within community forestry activities are likely to be observed.
- 2. Oldekop et al. Does community forestry user group presence affect forest cover outcomes in Nepal?
- 3. Oldekop et al. Are community rights arrangements in Nepal associated with livelihood outcomes?
- 4. Oldekop et al. What is the relationship between forest cover and poverty effects of community forests in Nepal?
- 5. "Reassessing Vulnerability to Climate Change: Lessons from a Household-Plot Panel in Tanzania."

Vulnerability has become a key concept in understanding and predicting impacts of climate change on the world's rural poor. The term focuses on three main components: exposure, sensitivity, and adaptive capacity. This paper explores other variables capturing mortality, morbidity, and nonfood expenditure that may more parsimoniously describe vulnerability while incorporating these basic elements. Using a detailed household-plot panel dataset from the World Bank's Living Standards Measurement Study in Tanzania and a natural experiment, we explore both the explanatory and predictive power of these variables in the east African context.

6. "Documenting lessons from research by the International Forestry Resources and Institutions (IFRI) network on developing policies and programs on community forestry"

# Papers in progress (UC Boulder):

- 7. The three papers are still working papers but are moving quickly towards submission at highimpact journals.
  - a. First paper: "Property rights and benefit sharing in community forests" by Torpey-Saboe, Andersson, Salk, Wright, Mwangi.

- b. Second paper: "Property rights and benefit sharing in community forests" by Torpey-Saboe, Andersson, Salk, Wright, Mwangi.
- c. "Decentralization and its effects on forests, livelihoods, and equality" by Andersson, Persha, Salk, Wright, and Torpey-Saboe.
- 8. "Decentralization and its effects on forests, livelihoods, and equality" by Andersson, Persha, Salk, Wright, and Torpey-Saboe.

#### **Presentations:**

- 1. IFRI: ICARUS IV Conference-Causes of vulnerability & livelihoods of the poor (May 7-9, UIUC).
- 2. IFRI: Impact Evaluation Approaches Workshop (related to DFID project).

#### Proposals for follow-on funding:

- Indiana University: A NSF proposal for the Coupled Natural-Human Systems competition (CNH) with Forrest Fleischman (PI, Texas A+M), Micelle Lawing (Texas A+M) and Pinki Mondal (Columbia U). "Evaluating the impact of national policy on dynamics of forest cover change across tropical Asia and Latin America"
- 2. CIFOR (funded): "Evidence-based Forestry" systematic review of community forestry. With a budget of \$72,000, this review team includes staff at UMich, CIFOR, RECOFTC. There is a website: <u>http://www1.cifor.org/ebf/reviews/current-reviews/systematic-reviews/social-and-ecological-outcomes-of-community-managed-forests.html</u>, introducing the systematic review, which also includes a video interview with Arun. Within the next week I hope that a working paper for the systematic review methodological protocol will also be published online.
- 3. IFRI (pending): Market Forces and Collective Resource Management in the Ecuadorian Amazon University of Colorado, Boulder Proposal for future research.

#### Student training/involvement:

- 1. Indiana University: Two graduate students worked with me to conduct a literature review and data analysis process to examine forest cover change in Central America under CAFTA, following criteria relevant to our SESYNC research project.
- 2. Kunning Institute of Botany, Chinese Academy of Science on 17-19 September 2014: organized a workshop to train participants from China, Loas, Thailand to use IFRI methodology in their research project on green rubber.

#### Tools/databases developed:

- 1. IFRI Tool, SR protocol: What are the biophysical, institutional and socioeconomic contextual factors associated with improvements in livelihood and environmental outcomes in forests managed by communities?
- 2. IFRI, Tool/dataset: Creation of a new IFRI dataset on approximately 280 variables to be launched in May 2015.

#### Comments:

*Anonymous:* As a result of my participation at these meetings, I have been able to co-develop three new research papers that uses IFRI data to test new ideas about the institutional conditions under which inequality outcomes within community forestry activities are likely to be observed.

*Anonymous:* As a result of my participation in these meetings, I alerted my Colleague Joanna Chan to apply for a SESYNC postdoctoral fellowship, which neither of us had heard of before.

Ocean Acidification Study; PIs: Linwood Pendleton, Sarah Cooley, and Lisa Suatoni Project Name: Human Impacts of Ocean Acidification

## **Publications:**

## Published:

1. Ekstrom, J., Suatoni, L., Cooley, S., Pendleton, L. and others. Vulnerability and adaptation of US shellfisheries to ocean acidification. *Nature Climate Change.* 

#### **Presentations:**

- 1. Vulnerability and adaptation of US shellfisheries to ocean acidification. Resiliency Meeting. Montpelier France.
- 2. Vulnerability of US shellfisheries to ocean acidification : research gaps and priorities, Govt. Accountability Office, Sept 2014
- 3. Vulnerability Analyses and Ocean Acidification, Maine Ocean Acidification Commission, Bath Maine, Nov 2014
- 4. Using Vulnerability Analyses to Prioritize OA Action, International Atomic Energy Agency, Monaco, Jan 2015
- Cooley, S.R. Invited talk. "Toolbox for quantifying effects of ocean biogeochemical change on human communities." 27 August 2013. WHOI Marine Chemistry & Geochemistry Departmental Seminar.
- 6. Cooley, S. Invited talk. "Ocean acidification in a social-ecological context and U.S. Ocean Acidification Research Activities." 6 March 2013. MedSeA Annual Meeting, Crete, Greece.
- 7. Cooley, S.R. Invited talk "Ocean acidification and Human Development." 30 May 2013. Macarthur Foundation Visit to WHOI.
- 8. Cooley, S. R. Talked about our approach to a group of PIs proposing an OA research coordination network in Canada through MEOPAR. April 15, 2014.
- 9. Ekstrom, J. Invited Talk. "Conducting a Vulnerability Assessment for Ocean Acidification." Resilience Conference (May 2014, France)
- 10. Ekstrom, J. CA Climate Adaptation Forum (Sacramento, August 2014)

#### Proposals submitted for follow-on research:

- Prince Albert II Foundation grant for ~\$100,000 (actually \$92k at the moment due to falling euro). The proposed work would extend our work to pursue novel analysis for the impacts of OA on coral reefs and the communities they support.
- 2. NRDC plans to collaborate with Island Institute of Maine to conduct a broader vulnerability for additional fisheries in Maine.

#### Students involved with project and/or trained:

- 1. Carolyn Dougherty (Masters student, Duke University)
- 2. Adrien Comte (Doctoral student, University of Brest)

#### Data, software, tools, and websites produced from synthesis efforts:

We used Seasketch.org to manage the following spatial data:

- combined coral ecosystem services (low elevation population protected by reefs and not mangroves, reef fisheries landings, landed value, jobs)
- combined ocean acidification, thermal stress, and cyclone data
- combined upwelling, estuarine, and aragonite data for US coastal waters
- combined human uses and dependencies for shellfish data in US coastal waters
- first ever data on adaptive capacity for shellfish-dependent communities in the US

#### Comments:

Benefitted:

- Question definition: Multidisciplinary team undertook a comprehensive examination of vulnerability (inclusion of multiple dimensions: physical, biological, economic, and social)
- Scope of data search: Broader reach for existing data sets
- Lively discussions!

# The Value of Biodiversity; PIs: Brad Cardinale and Ed Barbier

Project Title: Linking biodiversity and ecosystem services: From expert opinion to prediction and application

#### **Publications:**

# In review:

1. Letourneau, D.K., A. Ando, J. Jedlicka, A. Arwani, and E. Barbier. Estimating the Value of Biodiversity for Ecosystem Services: Biological Pest Control in Agriculture. *Ecological Economics*, in review.

# In prep:

2. Hungate, B. A., E. B. Barbier, A. Ando, S. P. Marks, P. B. Reich, N. van Gestel, G. D. Tilman, J. Knops, and B. J. Cardinale. The value of species conservation for carbon storage in a North American grassland. In prep for *Nature Climate Change*.

#### **Presentations:**

- 1. Cardinale, B. J. 2014. Biodiversity & the functioning of ecosystems: One summary of, and vision for, a paradigm. Oxford University, Department of Zoology.
- 2. Letourneau, D. K. 2014. Transforming agriculture with biodiversity. Social Science Division Research Frontiers Conference, University of California, Santa Cruz.
- Letourneau, D.K. 2014. Maintaining ecosystem services in the face of intensive production practices. Strategies to support both biodiversity and production in agricultural landscapes. EcoSciences Precinct, Dutton Park, Brisbane. Conference put on by CSIRO and sponsored by the OECD.
- 4. Paquette, A. Biodiversité, environnement et fonction des écosystèmes arborés: En forêt, en ville, et dans les champs. Séminaire invité, Université de Sherbrooke, 18 janvier 2013.

- 5. Barbler, E. A Spatial Model of Coastal Ecosystem Services. Seminar presentation at the National socio-Environmental Synthesis Center (SESYNC), Annapolis, MD, Jan 8, 2013.
- 6. Cardinale, B. J. 2012. Biodiversity, extinction, and their impacts on humanity. Stanford University, Department of Biology seminar series.
- 7. Departmental seminar. Cardinale, B. J. 2012. Biodiversity loss and its impact on humanity. University of Southern California, Wrigley Institute for Environmental Studies seminar series.

#### Student training/participation:

- 1. Carson Reeling, 3rd year PhD student in Ag, Food, and Resource Economics at Michigan State University is helping working group participant Richard Horan on the economic modeling of disease.
- 2. Julie Jedlicka, for Ph.D. student at UC-Santa Cruz with Deborah Letourneau (now a postdoc at UC-Berkeley).
- 3. Anita Narwani, former postdoc at Univ. of Michigan with Brad Cardinale (now a postdoc at Eawag, Swiss Federal Institute of Aquatic Science and Technology).
- 4. Bethany Hoye, former postdoc at Univ. Colorado with Pieter Johnson (now a postdoc at Deakin University Australia).
- 5. N. van Gestel, postdoc at Northern Arizona University with Bruce Hungate.
- 6. Samuel Marks, high-school student intern working with Bruce Hungate.

#### Proposals for follow-on research funding:

1. Deborah Letourneau & Amy Ando: Submitting a supplement by May 28th on the USDA grant to explain how data generated from the proposed project could be used in our valuation study for natural enemy diversity effects on organic broccoli production.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity

1. International Conference on Conservation Biology. Organized by Rodd Kelsey at The Nature Conservancy. August 2-6, 2015 in Montpellier, France.

# Land Use Change & Infectious Disease; PIs: Andrew Dobson, Nita Bharti, and Matthew Bonds

Project Title: Understanding how land-use change impacts the dynamics of vector-borne and water borne infectious disease of humans and domestic livestock

#### **Publications:**

A set of at least five papers are currently in development. Three of these deal with different aspects of how habitat loss and fragmentation impact the dynamics of different classes of pathogens: vector borne, pathogens with reservoir hosts and directly transmitted pathogens. The three papers focus on (1) transmission between patch and matrix as the length of the boundary changes; (2) pathogen community dynamics in patches of sizes; (3) transmission and persistence of pathogens as natural habitat is fragmented into an increasing number of smaller patches.

A sub-set of us have put together a new class of model that couples habitat conversion and disease dynamics with human economic decisions and demography. We are developing drafts of manuscripts describing this model and its analysis.

A second sub-group is focusing on the dynamics of pathogens in cities of different sizes and different stages of development. This group is developing a proposal to fund a workshop to run in parallel with the one on land-use change and pathogen dynamics.

#### **Presentations:**

1. Symposium at ESA 100th Meeting in Baltimore will be the big roll-out of our findings.

#### Proposals submitted for follow-on research:

- 1. We are developing a couple of follow-up proposals (1) for a working group on pathogens in developing cities for the Santa Fe Institute.
- 2. We have developed a collaboration with a group of French economists for a series of workshops on Disease and Poverty this builds heavily on work initiated at SYSENC and NCEAS.
- 3. Bonds and others have submitted proposals to NSF EID and CHN programs to explore aspects of the work developed at SYSENC and NCEAS to studies of poverty, disease and land-use change in Ranomafana, Madagascar.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

- 1. Symposium at ESA 100 Meeting at Baltimore, August 2015. Land Use Change and Infectious Disease.
- 2. Ecological Economics of Disease and Poverty Workshops in Paris, France (November 2014) and Marseilles, July 2015.

# Students involved with project and/or trained:

1. Christina Faust, GS, Princeton University.

#### Stories related to your synthesis efforts:

The research emerging from the working group is fascinating and insightful at many levels.

- 1. There is considerable controversy in the ecological literature about the role that host species diversity has on buffering, or amplifying, epidemic outbreaks. The work from the landscape fragmentation groups provides an important 'null model' for examining this question.
- 2. The work on pathogens in cities has hugely underlined how the development of large scale connected populations of humans provide a vast resource for pathogens and how public transport and education systems have to be managed to reduce risks of disease outbreaks.
- 3. The work on economics, disease and land-use change have caused us to question the fundamental assumptions underlying a lot of economic theory eventually this has allowed us to develop new models that provided important insights into the ways in which pathogens modify human economic decisions about how to modify and develop landscapes.

# Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

This will follow once papers are submitted for publication Publicity in popular press: This will follow once papers are submitted for publication.

#### Comments:

SEYSNC has proved an excellent location for us to work on these problems. It provides a stimulating, but sufficiently isolated, atmosphere that allows us to brainstorm and develop concepts and analysis that require several consecutive days of deep discussion that leads to the symbiotic development of models that reflect the underlying dynamics of the processes we're interested in explaining. There is no facility at any of our home institutions that allows us to work together in this way.

# Macroevolution of Ecosystem Services; PIs: Jeannine Cavender-Bares and Stephen

#### Polasky

Project Title: Macroevolution of Ecosystem Services from Trees

#### **Publications:**

#### Book chapter:

A book chapter is also partially attributable to the working group: "Pearse, William D., et al. "Metrics and Models of Community Phylogenetics."Modern Phylogenetic Comparative Methods and Their Application in Evolutionary Biology. Springer Berlin Heidelberg, 2014. 451-464."

#### **Presentations:**

- Jeannine Cavender-Bares (PI, University of Minnesota) delivered a presentation at the 99th Ecological Society of America meeting on "Evolutionary hot spots and temporal trends in the ecosystem services derived from plants," J. Cavender-Bares, William F. Fagan, Matthew R. Helmus, Nathan Kraft, Jesse R. Lasky, Ian Muñoz, Erik J. Nelson, David J. Nowak, William D. Pearse, Steve Polasky, Mary Shelley, Amy E. Zanne, as part of the Symposium: Operationalizing the Concept of Ecosystem Services through Interdisciplinary Research and Synthesis, 99th Ecological Society of America Meeting, Sacramento, Aug. 2014.
- Jesse Lasky (post doc, Department of Ecology, Evolution & Environmental Biology, Columbia University) gave a presentation at the Columbia University Earth Institute Fellows Symposium titled "Evolutionary diversity of useful plants" Wednesday, November 6, 2013 that was partly about the working group projects.

#### Tools/databases developed:

Jeannine Cavender-Bares and Amy Zanne attended the Software Carpentry Bootcamp at Sesync in December 2013. These skills are critical to advancing the data analyses for the working group. Specifically, these skills enabled Jeannine Cavender-Bares to contribute to the pez R package:online (http://cran.r-project.org/web/packages/pez/index.html), citation "William D. Pearse, Marc W. Cadotte, Jeannine Cavender-Bares, Caroline Tucker, Steve C. Walker and Matthew R. Helmus (2014). pez: Phylogenetics for the Environmental Sciences. R package version 0.9-0." The package, led by participant Will Pearse, benefited from the working group interactions and code development for analyses of the project data. We are using tools in the package for analysis and visual display of ecosystem services in the tree of life.

#### Student training/involvement:

Jeannine Cavender-Bares and Steve Polasky will use insights from the working group in the Distributed Graduate Seminar in Sustainability Science that we are teaching across four institutions: University of Minnesota, Arizona State University, Universidad Autónoma de Mexico in Morelia, Mexico; Universidade de Sao Paulo in Brazil. The seminar goal this year is to juxtapose, discuss and develop new insights arising from differing cultural, political, economic, and ecological perspectives from Latin America and the U.S.

#### Other:

Jeannine Cavender-Bares was recently awarded a Leopold Leadership Fellow (<u>http://leopoldleadership.stanford.edu/</u> to learn skills for communicating science to a broad public audience; the fellowship was awarded in part based on the biodiversity work at SESYNC.

# Tropical Coastal Resilience; PIs: Ellen Hines and Rebecca Lewison

Project Title: Developing an integrated framework to model resilience of the coupled human/natural environment in tropical coastal systems

#### **Publications:**

#### In prep:

- 1. Lewison et al. Using DPSIR frameworks to characterize, model and manage for resilience in coastal systems: linking conceptual development to management applications. To be submitted to *Ocean Coastal Management*. Targeted submission date: end of February 2015.
- 2. Lieske et al. Spatial systems and conservation planning approaches to addressing the modeling of tropical coastal systems with the DPSIR framework in Trat Province, Thailand and Koh Kong Province, Cambodia. To be submitted to *Environmental Modelling and Software*. Targeted submission date: July 2015.

#### **Presentations:**

 Ecological Society of America, August 2014. Lewison et al. Developing an integrated framework to model resilience of the coupled human/natural environment in tropical coastal systems. Juried oral presentation.

#### Proposals submitted for follow-on research:

- 1. University of the Sunshine Coast Internal Collaboration Grant: PI: Drs. Scott Lieske, Claudia Baldwin, Christian Jones, Maria Beger for funding to attend January workshop in Thailand.
- 2. Asian Pacific Network (APN) Visualisation for climate adaptation planning along tropical coasts: managing vulnerability and resilience of coupled human/natural environments. Preliminary

proposal accepted, full proposal pending. Drs. Claudia Baldwin, Scott Lieske, Ellen Hines, Rebecca Lewison.

- 3. Open and Collaborative Science in Development Projects (International Development Research Centre): Developing an integrated framework to visually model vulnerability and resilience of the coupled human/natural environment in tropical coastal systems for climate adaptation planning. Preliminary proposal accepted and our PI was selected for participation in a workshop in Nairobi. After the workshop the PI withdrew for health reasons. We will resubmit for the next call for proposals. PI: Dr. Suvaluck Satumanatpan, Co-PI's: Ellen Hines, Rebecca Lewison, Ratana Cheunpagdee.
- 4. International Social Science Council: Transformations to Sustainability Program. Coastal Models to Assess Pathways to Sustainability, PI: Dr. Murray Rudd, not funded.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

We were invited by the Thai Department of Marine and Coastal Resources to conduct a workshop in Trat Province, January 2015. The workshop, entitled: "Workshop on integration of management and sustainable usage of marine and coastal resources in ASEAN region by using DPSIR framework", was a week-long series of presentations and discussions funding by ASEAN. Participants included 20 Thai scientists from Thai government agencies, representatives from IUCN in Bangkok, and NGO representatives. A Cambodian delegation included the Deputy Minister of Fisheries and Fisheries agency personnel from Koh Kong province. Vietnamese delegates included students from the Southern Ecology University and Kien Gang Provincial agencies. Two Malaysia scientists were involved, research professors at Malaysian Universities.

#### Students involved with project and/or trained:

1. Wissam Al-Hayek, a PhD student in environmental economics and environmental management at York University, UK Research Assistant hired at University of Sunshine Coast Australia working on gathering spatial data in preparation for planning support systems / spatial systems / Marxan modelling

#### Stories related to your synthesis efforts:

Our research efforts have highlighted the importance of this integrated research approach-- in developed and developing countries alike. The opportunity, through SESYNC, to bring in our Thai collaborators from the inception has been instrumental to our project's success, productivity, and led to buy-in from the Thai Government. During this recent workshop (see above), we have had expressions of interest in expanding this network to include Malaysia, Vietnam and Cambodia. As well, Thai delegates and agency scientists are excited about continuing this collaborative project.

Role of Green Infrastructure: Barbara Minsker, Stan Ahalt, and Larry Band Advancing research on the perception, role, and function of urban green infrastructure by bridging the SESYNC synthesis process with an open community engagement process for software development

#### **Publications:**

#### Journal articles and conference proceedings:

- Ahalt, Stan and Band, Larry and Christopherson, Laura and Idaszak, Ray and Lenhardt, Chris and Minsker, Barbara and Palmer, Margaret and Shelley, Mary and Tiemann, Michael and Zimmerman, Ann (2014). Water Science Software Institute: Agile and Open Source Scientific Software Development. *IEEE Computing in Science Engineering*. 16 (3), 18-26.
- Ahalt, S., Band, L., Minsker, B., Palmer, M., Tiemann, M., Idaszak, R., Lenhardt, C., Whitton, M. (2013). Water Science Software Institute: An Open Source Engagement Process. 2013. International Workshop on Software Engineering for Computational Science and Engineering (SE---CSE13); San Francisco, California; May 18, 2013.

# Submitted:

3. Miles, B., Tague, C., Band, L.E. (submitted). Toward a common framework for ecohydrology model data preparation workflows: EcohydroLib. *Environmental Modelling and Software*.

# Reports, white papers and other non-refereed materials:

- 4. Evaluation Findings from the January 21--23, 2014 GI Venture Meeting, Executive Summary, Overview of the Water Science Software Institute And Summary of Prototyping Activities, June 17, 2013. Retrieved Feb 02, 2015 from https://collab.sesync.org/groups/green\_infrastructure/\_layouts/15/WopiFrame.aspx?sourcedoc =/groups/green\_infrastructure/Shared%20Documents/GI%20Venture%20SESYNC%20Survey%2 0Feb%2003%202015/WSSI\_short\_summary\_report\_June\_2013.pdf&action=default
- Water Science Software Institute (WSSI) Hackathon addressing the Regional Hydro-Ecologic Simulation System (RHESSys), July 14, 2013. Retrieved Feb 02, 2015 from https://collab.sesync.org/groups/green\_infrastructure/\_layouts/15/WopiFrame.aspx?sourcedoc =/groups/green\_infrastructure/Shared%20Documents/GI%20Venture%20SESYNC%20Survey%2 0Feb%2003%202015/WSSI\_Hackathon\_Report.pdf&action=default
- 6. A Second WSSI Hackathon addressing the Regional Hydro-Ecologic Simulation System (RHESSys), Report and Recommendations, October 2013. Retrieved Feb 02, 2015 from https://collab.sesync.org/groups/green\_infrastructure/\_layouts/15/WopiFrame.aspx?sourcedoc =/groups/green\_infrastructure/Shared%20Documents/GI%20Venture%20SESYNC%20Survey%2 0Feb%2003%202015/Hackathon%20II%20report.pdf&action=default
- 7. An informal report to accompany the presentation on findings from an observation of the first Green Infrastructure Venture Meeting, October 28, 2013. Retrieved Feb 02, 2015 from https://collab.sesync.org/groups/green\_infrastructure/\_layouts/15/WopiFrame.aspx?sourcedoc =/groups/green\_infrastructure/Shared%20Documents/GI%20Venture%20SESYNC%20Survey%2 0Feb%2003%202015/Report%20to%20accompany%20presentation%20of%20findings%20from %20an%20observation%20GI%20Venture\_2013.pdf&action=default
- Evaluation Findings from the January 21--23, 2014 GI Venture Meeting, Executive Summary, Retrieved Feb 02, 2015 from https://collab.sesync.org/groups/green\_infrastructure/\_layouts/15/WopiFrame.aspx?sourcedoc =/groups/green\_infrastructure/Shared%20Documents/GI%20Venture%20SESYNC%20Survey%2 0Feb%2003%202015/GIVenture-JanMtg2014-EvalSummary.pdf&action=default
- 9. Koch, B., Miles, B., et. al., Advancing Water Science through Improved Cyberinfrastructure, poster presented at the 2012 American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, Dec 3-7, 2012.
- 10. Christopherson, L., Idaszak, R, & Ahalt, S. (2013). Developing scientific Software through the Open Community Engagement Process. Workshop toward Sustainable Software for Science, http://dx.doi.org/10.6084/m9.figshare.790723.

#### **Presentations:**

- NSF-invited WSSI talk, referencing SESYNC, given by WSSI PI Stan Ahalt at the Interagency Steering Committee on Multimedia Environmental Modeling (ISCMEM) in Reston, VA, Nov 8, 2012.
- 2. Ahalt et. al, Water Science Software Institute, poster part of the NSF SI2 workshop, Arlington, VA, Jan 16-18, 2013.
- 3. Ahalt et. al, Conceptualization of a Water Science Software Institute, presentation at the NSF SI2 workshop, Arlington, VA, Jan 16-18, 2013.
- 4. Ahalt, S., Conceptualization of a Water Science Software Institute, part of a plenary panel titled "What does it mean to Conceptualize?", NSF SI2 workshop, Arlington, VA, Jan 16-18, 2013.
- 5. Stan Ahalt presented the Water Science Software Institute at SESYNC as part of SESYNC Water Theme Meeting, SESYNC, Annapolis, MD, June 11-12, 2013.
- 6. A paper titled "Water Science Software Institute An Open Source Engagement Approach" published in the IEEE 2013 International Workshop on Software Engineering for Computational Science and Engineering proceedings, Feb 28, 2013, is subsequently presented by Ray Idaszak at the IEEE 2013 International Workshop on Software Engineering for Computational Science and Engineering, San Francisco, CA, May 17-18, 2013.
- WSSI PI Stan Ahalt discusses WSSI and Open Community Engagement Process, including SESYNC, as part of Software Institute plenary session at ESIP Federation Summer Meeting, Chapel Hill, NC, July 10, 2013.
- WSSI, referencing SESYNC, formally presented by Ray Idaszak at ESIP Panel titled "Promoting Science Software Best Practices," ESIP Federation Summer Meeting, Chapel Hill, NC, July 11, 2013.
- WSSI PI Stan Ahalt delivers invited keynote presentation on the Water Science Software Institute (referencing SESYNC) at the CUAHSI Informatics 2013 Conference, Logan, UT, July 18, 2013.
- 10. Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, University of Maryland, November 14, 2013.
- 11. Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, CSIRO, Melbourne, Australia, March 3, 2014.
- 12. Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, Monash University, Melbourne, Australia, March 11, 2014.
- 13. Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, University of Adelaide, Adelaide, Australia, March 19, 2014.
- 14. Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, City of Melbourne, Melbourne, Australia, April 7, 2014.
- 15. Stan Ahalt served on an invited panel for iEMSs (http://www.iemss.org/sites/iemss2014/). June 15-19, 2014, where he talked about WSSI and OCEP and referencing SESYNC.
- 16. Minsker, B., A New Framework for Green Infrastructure Modeling and Decision Support Services, National Taiwan University, Taipei, Taiwan, November 3, 2014.
- 17. Minsker, B., A New Framework for Green Infrastructure Modeling and Decision Support Services, National Flood Interoperability Experiment (NFIE) Steering Committee Meeting, Tysons, VA, November 6, 2014.
- Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." Florida International University of Miami, FL, 2/14/2014.

- 19. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." College of Charleston, Charleston, SC, 4/7/2014.
- 20. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." Stanford University, Stanford, CA, 4/29/2014.
- 21. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." Beijing NU, Beijing, China, 5/29/2014.
- 22. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." University of Melbourne, Melbourne, Australia, 8/14/2014.
- 23. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." Smith College Northampton, MA, 9/11/2014.
- 24. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." UNC-What's the Big Idea Event Friday Center, Chapel Hill, 10/30/2014.
- 25. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." Cardiff University, Cardiff, Wales, UK 11/6/2014.
- Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." London, UK 11/7/2014.
- Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." SE Stream Restoration Conference, Charlotte, NC, 11/8/2014.
- 28. Band, Lawrence E., Geological Society of America Hydrogeology Division Birdsall--Dreiss Distinguished Lecture, "Green infrastructure, groundwater and the sustainable city." University of Wisconsin, Madison, WI, 12/4/2014.

# Proposals submitted for follow-on research:

# FUNDED BY NSF:

- 1. Collaborative Research: CyberSEES: Type 2: A New Framework for Crowd-Sourced Green Infrastructure Design <u>http://www.nsf.gov/awardsearch/showAward?AWD\_ID=1331807</u>
  - 1) Barbara Minsker minsker@illinois.edu (Principal Investigator)
  - 2) William Sullivan (Co-Principal Investigator)
  - 3) Arthur Schmidt (Co-Principal Investigator)
  - 4) Jong Lee (Co-Principal Investigator)
  - 5) Kenton McHenry (Co-Principal Investigator)
  - 6) http://nsf.gov/awardsearch/showAward?AWD\_ID=1331813
  - 7) Lawrence Band Iband@email.unc.edu (Principal Investigator)
  - 8) Mary Whitton (Co-Principal Investigator)
  - 9) Jack Snoeyink (Former Co-Principal Investigator)
- 2. INTERNATIONAL SUPPLEMENT TO NSF AWARD #1216817 FUNDED BY NSF

Under an international supplement to NSF Award #1216817, in March and April 2014, GI Venture PI Barbara Minsker visited research organizations and cities in Australia regarding Green Infrastructure research and software.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

*Alex Felson (a participant):* I am coordinating with Larry Band to link the efforts in SESYNC to the Earth Stewardship Initiative Demonstration Project taking place in 2015 in Baltimore Maryland. Here is the website for last year's demonstration project. We are doing something similar in Baltimore working with the Baltimore Ecosystem Study, Parks and People, the City of Baltimore, multiple universities (Yale, UMD, UVA, Penn State, Rutgers, Morgan State).

www.EarthStewardshipESA2014.com

#### SESYNC MEETINGS

- 1. June11-12, 2013, SESYNC, SESYNC Water Theme Meeting, Barbara Minsker (5) A prototypical traversal of the WSSI Open Community Engagement Process addressing "What is the effects of urban green infrastructure (GI) on the fate and transport of stormwater and nutrients within watersheds?" were prototyped and iterated as follows:
  - a) A WSSI OCEP Spec'ing meeting was held at RENCI, Chapel Hill, NC Feb 19-20, 2013
  - b) A WSSI OCEP Boot camp for a hydrology software model was held at RENCI, Chapel Hill, NC, March 27-28, 2013.
  - c) A WSSI OCEP development hackathon held at RENCI, Chapel Hill, NC, April 15-19, 2013.
  - d) A WSSI OCEP refinement on the above hackathon was held at RENCI, July 22-24, 2013.

2.	July 22-24 2013	SESYNC	GI Venture Planning Meeting	Barbara Minsker (7)
3.	September 11-12 2013	SESYNC	GI Venture Workshop	Barbara Minsker (31)
4.	January 21-23 2014	SESYNC	GI Venture Workshop	Barbara Minsker (23)
5.	May 13-16 2014	SESYNC	GI Venture Workshop	Barbara Minsker (27)
6.	Sept 29-Oct 2 2014	SESYNC	GI Venture Workshop	Barbara Minsker (39)
7.	February 2-4 2015	SESYNC	GI Venture Workshop	Barbara Minsker (27)

#### EXTERNAL MEETING

8. On January 29th, Larry Band and Brian Miles met with five personnel from Durham, NC Stormwater and GIS Services to discuss their interest, activity and active programs in the implementation of Green Infrastructure. John Cox, Water Quality Manager for the City of Durham, is one of the municipal advisors for the SESYNC project, and hosted the meeting. Discussions centered on the goals, barriers, methods and extent of Green Infrastructure implementation in Durham, and demonstrating and reviewing pilot spatial analytical and modeling software with applications to Durham stormwater. A test watershed in Durham which is the subject of an experimental reverse auction for GI on private property was simulated with RHESSys and presented to generate discussion on needs and utility of new stormwater software. The meeting was scheduled originally for two hours, but continued for three hours due to interest and planning for follow on projects.

#### WORKSHOPS:

- 9. A Water Science Software Institute workshop with steering committee and advisors was held at SESYNC, Annapolis, MD, October 21-23, 2012.
- 10. The University of North Carolina's Renaissance Computing Institute (RENCI) and UC Santa Barbara's National Center for Ecological Analysis and Synthesis (NCEAS) co-lead a a unique bi-

coastal Open Science for Synthesis (#OSS2014) event as a three-week intensive training workshop with participants in both Chapel Hill, NC and Santa Barbara, CA from July 21 - August 8, 2014. The training was sponsored by the Water Science Software Institute (WSSI) and Institute for Sustainable Earth and Environmental Software (ISEES), both of which are conceptualizing an institute for sustainable scientific software. 45 national and international student participants received hands-on guided experience using best practices in the technical aspects that underlie successful open science and synthesis – from data discovery and integration to analysis and visualization, and special techniques for collaborative scientific research, including virtual collaboration over the Internet. The following students attended the workshop:

#### **RENCI Student Participants:**

- 1) Annie Adelson, Stanford University
- 2) Olivia Burge, University of Canterbury
- 3) Benjamin Carr, Boston University
- 4) Tony Chang, Montana State University
- 5) Jonathan Duncan, University of North Carolina at Chapel Hill
- 6) Emma Fuller, Princeton University
- 7) Tian Gan, Utah State University
- 8) Kelly Garbach, Loyola University Chicago
- 9) Edgar Gonzalez, Universidad Nacional Autonoma de Mexico
- 10) Monica Granados, McGill University
- 11) Elizabeth Kalies, University of Missouri/NC Museum of Natural Sciences
- 12) Ingrid Knapp, University of Hawaii, Manoa
- 13) Nina Lany, Dartmouth College
- 14) Marissa Lee, Duke University
- 15) Silvia Lomascolo, Universidad Nacional de Tucuman
- 16) John Lovette, University of North Carolina at Chapel Hill
- 17) Vanessa Michelou, University of Hawaii, Manoa
- 18) Pamela Reynolds, University of California, Davis
- 19) Zahra Samadi, University of South Carolina
- 20) Kes Schroer, Dartmouth College
- 21) Michael Treglia, Texas A&M University
- 22) Tyson Wepprich, North Carolina State University

#### **NCEAS Student Participants:**

- 23) Georgina Adams, Imperial College London
- 24) Timothy Assal, USGS/Colorado State University
- 25) Leah Bremer, Stanford University
- 26) Julia Buck, Sam Houston State University
- 27) Mary Donovan, University of Hawaii
- 28) Debora Drucker, EMBRAPA
- 29) Vicken Hillis, University of California, Davis
- 30) Megan Jennings, San Diego State University
- 31) Suzanne Langridge, University of California, Santa Cruz
- 32) Sparkle Malone, Rocky Mountain Research Station
- 33) Rachael Orben, University of California, Santa Cruz
- 34) Antonio Jesús Pérez Luque, University of Granada
- 35) Katherine Renwick, Colorado State University
- 36) Annie Schmidt, Point Blue Conservation Science

- 37) Paul Selmants, University of Hawaii, Manoa
- 38) Diego Sotomayor, York University
- 39) Brian Stock, Scripps Institution of Oceanography, University of California, San Diego
- 40) Lynn Sweet, University of California, Santa Barbara
- 41) Christopher Trisos, South African Environmental Observation Network
- 42) Mirela Tulbure, University of New South Wales
- 43) Sara Varela, Charles University
- 44) Lynn Waterhouse, Scripps Institution for Oceanography, University of California, San Diego
- 45) Jennifer Weaver, University of California, Berkeley

#### Students involved with project and/or trained:

#### Student name and affiliation:

- 1) Ankit Rai, University of Illinois, Urbana-Champaign
- 2) Ariel Wang, University of Illinois, Urbana-Champaign
- 3) Bardia Heidari Haratmeh, University of Illinois, Urbana-Champaign
- 4) Brian Miles, UNC Chapel Hill
- 5) Clinton Freeman, UNC Chapel Hill
- 6) Danwei Li, UNC Chapel Hill
- 7) Fabian Alfredo Neira, University of Illinois, Urbana-Champaign
- 8) Heidari Haratmeh Bardia, University of Illinois, Urbana-Champaign
- 9) Jordan Reese, UNC Chapel Hill
- 10) Kate Hagemann, Yale University
- 11) Pongsakorn Suppakittpaisarn, University of Illinois, Urbana-Champaign
- 12) Samuel Rivera, University of Illinois, Urbana-Champaign
- 13) Simon Gore, Yale University
- 14) Sterling Auston, UNC Chapel Hill
- 15) Sun Young Park, University of Illinois, Urbana-Champaign
- 16) Vance Miller, UNC Chapel Hill
- 17) Xiangrong Jiang, University of Illinois, Urbana-Champaign
- 18) Rosemary Fanelli, University of Maryland
- 19) Ben Koch, University of Maryland

# Postdocs involved with the project:

- 20) Mary Collins, SESYNC
- 21) Taehee Hwang, UNC Chapel Hill
- 22) Jon Duncan, UNC Chapel Hill
- 23) Kristina Hopkins, SESYNC

#### Data, software, tools, and websites produced from synthesis efforts:

As part of this SESYNC GI Venture a set of datasets were collected for 6 counties in the US (Cook County, IL; Durham County, NC, Baltimore City County and Baltimore County, MD; Maricopa County, AZ; Multnomah County, OR). The collected data is associated with the socio-economic, ecologic and infrastructure vulnerability in urban environments and includes an array of ~60 variables. The spatial resolutions of the data ranges from 10-30 m grid cells to Census tracts, and include point (e.g., crime incidences, location of schools and hospitals, etc.), field/raster (e.g., surface temperature, terrain elevation, vegetation cover, land use, etc.) and area data types (e.g., US Census data, building footprints, etc.).

All this data was collected from "freely" data sources and include a combination of federal government agencies (e.g., USGS, NOAA, FEMA, etc.) and different city agencies (e.g., Department of Planning, etc.). In addition to this dataset, available data associated with the location and type of constructed and planned green infrastructure project for each of this county was collected. Finally, data collected from a set of surveys and interviews conducted at each of the 6 counties with a range of different stakeholders is also available. These surveys and interviews were design to understand the different drivers and challenges associated with the process of designing, planning and installing green infrastructure project. All these datasets will be made available through MEDICI, a National Center of Supercomputer Applications (NSCA) data repository, upon completion of the project.

# Software and tools:

- Performance of the CF9 (i.e. Create Flow version 9) routine within RHESSys went from O(n^2) in speed to O(log(n)) overall and O(n) in places as a result of code refactoring during the Hackathons
- 2. A flow table editor was written for RHESSys
- 3. A GI Streetview Editor was written allowing interactive placement of Green Infrastructure on a parcel of land
- 4. The Medici software and DataWolf software from NCSA were configured as a GI MapViewer application that facilitates discovering and sharing all types of data related to GI
- 5. The NSF-funded HydroShare software was enhanced to facilitate RHESSys computational model runs soon to use GI placement from the GI StreetView Editor as input
- 6. We are planning to submit a supplement to improve interoperability between the NCSA and HydroShare software in support of research needs identified in this Venture.

# Stories related to your synthesis efforts:

The intensive collaborations between disciplines have brought profound insights that have deepened our individual research agendas and enabled our work to be much more relevant to real-world problems. Barbara spent time in Melbourne, Adelaide, and Chicago during her sabbatical in 2014 and stakeholders were fascinated by our efforts and highly interested in collaborating. This led to her appointment on a steering committee for Chicago's submission to the \$1 billion National Disaster Resiliency Competition, an invitation to submit a proposal for funding by the Metropolitan Water Reclamation District (in preparation), and seed funding for a new center at the University of Illinois Urbana-Champaign that will leverage this group's work.

# Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt., business]:

- April 7, 2014 Presentation and Meeting: Minsker, B., Sustainable and Resilient Cities: Novel "Big Data" Approaches to Improving Human and Ecosystem Wellbeing, City of Melbourne, Melbourne, Australia. Presented work on GI Venture thus far and engage in discussion on how our project and software can assist them.
- 2. November 13, 2014 Green Infrastructure Workshop, Chicago, IL. GI Venture PI and colleagues visited Chicago City Water Managers to present work in GI Venture thus far and engage in discussion on how our project and software can assist them.

3. February 2, 2015 Meeting: GI Venture PI and colleagues visited Baltimore City Water Managers to present work in GI Venture thus far and engage in discussion on how our project and software can assist them.

# Publicity in popular press:

- ExoGENI Website (September 10, 2014): Using ExoGENI for training in reproducible synthesis research <u>http://www.exogeni.net/2014/09/using-exogeni-for-training-in-reproducible-</u> synthesis-research/
- RENCI Blog (August 27, 2014): Codefest to focus on collaboration and results <u>http://renci.org/blog/codefest-to-focus-on-collaboration-and-results/</u>
- RENCI Website (August 11, 2014): Software Skills for Scientists <u>http://renci.org/news/software-skills-for-scientists/</u>
- NCEAS Website (August 2014):Open Science for Synthesis: Announcing the 2014 program participants <u>https://www.nceas.ucsb.edu/news/open-science-synthesis-announcing-2014program-participants</u>
- 5. RENCI Website (July 31, 2014): A techie marathon: RENCI hosts "Hackathon" to improve water science software <u>http://renci.org/news/a-techie-marathon-renci-hosts-hackathon-to-improve-water-science-software/</u>
- 6. RENCI Blog (July 16, 2014): In Science Software Matters <a href="http://renci.org/blog/in-science-software-matters/">http://renci.org/blog/in-science-software-matters/</a>
- 7. National Center for Ecological Analysis and Synthesis (NCEAS) Website (July 2014) Open Science for Synthesis – 2014 <u>https://www.nceas.ucsb.edu/OSS</u>
- 8. National Socio-Environmental Synthesis Center (2014) Water Science Software Institute <u>http://www.sesync.org/water-science-software-institute</u>
- 9. RENCI Website (March 18, 2014) Open Science for Synthesis Workshop targets early career scientists <u>http://renci.org/news/open-science-for-synthesis-workshop/</u>

# Comments:

SESYNC's "synthesis methodology" is highly effective. Having a structured process early-on during our initial collaborations proved to be a key aspect of forging a strong synthesis effort, even though the process felt cumbersome initially. The insights and cross-disciplinary connections that occurred in intensive multi-day retreats at SESYNC have been invaluable and would not have been possible in shorter-term or remote meetings. These provided the necessary visioning, ideas, and problem solving that were needed to sustain us between meetings. We found that scheduling monthly two-hour webinars were essential to continued progress between SESYNC meetings.

Further, recognizing the cross-domain challenges in vocabulary use explicitly served our synthesis by making everyone aware of the fact that idiosyncratic terminology was to be either avoided or carefully explained. These lessons have persisted in our subsequent workshops and meetings, and have been invaluable.

# Renewable Energy from Wastewater; PIs: Stephen Gabriel, Lars Olson, and Elisabeth

# Gilmore

Renewable energy from wastewater: A synthesis of the agricultural, energy, and transportation sectors and environmental tradeoffs

#### **Publications:**

#### In review:

1. C. U-tapao, S.A. Gabriel, C. Peot, and M. Ramirez, "A Stochastic MPEC for Sustainable Wastewater Management."

#### **Presentations:**

- 1. An SOS1-based Approach for Solving MPECs with Applications in Energy, EURO 2013 Conference, Rome, Italy, July 3, 2013 (with C. U-tapao, S. Siddiqui).
- 2. MPECS with Energy Applications (lead talk for Mini-Symposium on Applications and Solutions for Non-convex Stochastic Programs), 13th International Conference on Stochastic Programming, Bergamo, Italy, July 8, 2013 (with C. U-tapao and S. Siddiqui).
- 3. Optimization and Equilibrium Modeling for Renewable Energy: Focus on Wastewater-to- Energy Using a Two-Level Optimization Problem, Steven A. Gabriel Chalida U-tapao, PhD Winter School 2014, Bad Hafgastein, Austria
- 4. Optimization and Equilibrium Modeling for Renewable Energy: Focus on Wastewater-to-Energy Using a Two-Level Optimization Problem, Steven A. Gabriel Chalida U-tapao, MOPTA, 13-15 August 2014, Lehigh University, Bethlehem, PA.

#### Proposals submitted for follow-on research:

 Proposal to DC Water and Sewer Authority Continued Development of the Sustainable Wastewater Management Model (SWMM) September 24, 2014 (awaiting funding decision as of Jan. 8, 2015).

#### Students involved with project and/or trained:

- 1. Chalida u-Tapao (now professor in Thailand) Seksun Moryadee (defended thesis Dec. 2014).
- 2. Brittany Ryan, 09/2013 05/2014, Graduate Student in Master of Public Policy Degree.

# Data, software, tools, and websites produced from synthesis efforts:

Sustainable Wastewater Management Model (SWMM), large-scale stochastic mathematical program with equilibrium constraints.

#### Stories related to your synthesis efforts:

Discussed policy, engineering, and economics synthesis of the work with colleagues at several domestic and international conferences and the role of wastewater-to-energy programs.

# Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

Met with District of Columbia Water and Sewer Authority (also parallel contract) to use the SESYNC aspects to further their public/private profile relative to: sustainability (e.g., wastewater to energy, wastewater to compressed natural gas as transportation fuel) while considering revenue aspects.

#### Comments:

Very happy with the interface with SESYNC. We appreciate the financial and other support.

Decision-Support Tools for Pest Control; PIs: Daniel Karp and Becky Chaplin-Kramer Project Title: Evidence and decision-support tools for controlling agricultural pests with conservation interventions

#### **Presentations:**

- 1. Daniel Karp presented the project and solicited feedback at the Swedish University of Agricultural Sciences in Uppsala. Through the morning seminar and meeting, we established a collaboration with Riccardo Bommarco's group.
- 2. Katja Poveda presented briefly on our project at the Entomological Society of America meeting in Portland. Her main goal was to solicit data to build our pest control dataset.
- 3. Becky Chaplin-Kramer was accepted to present our work at the International Association of Landscape Ecology (IALE) World Congress in July. She will outline our progress to date.

#### Datasets or tools developed:

We are in the process of compiling a global, spatial pest control dataset. We have outlined the desired data in data template. It solicits information on sites, pests, predators, and crop yields. We have received good responses so far from our team members and have compiled many datasets. Now, we are expanding beyond our participants to solicit data from the wider community. This will continue until March 1.

#### Student or postdoc training/participation in the project (even if they did not come to SESYNC):

- 1. So far, three postdocs (including myself!) are closely involved in the project, having attended the first meeting at SESYNC.
- 2. Also present were two graduate students who have had limited previous international/interdisciplinary academic collaboration.

#### Proposals for follow-on research funding:

No proposals are planned; however, there is some supplemental funding available from the Natural Capital Project.

#### Engagement and/or exchange with knowledge users:

We have spoken regularly with project members at Biodiversity International and IFPRI of the CGIAR. The CGIAR represents our core user of the pest control model and our initial model ideas have been developed iteratively with their staff. Models for Citizen-Science Insect Data; PIs: Daniel Sheldon, Justin Calabrese, and Leslie Ries

Project Title: Models to unleash the power of citizen-science insect data for science, policy, education, and conservation

# **Presentations:**

1. Kevin Winner, Daniel Sheldon. Inference in a partially observed queuing model with applications to ecology. AAAI workshop on Computational Sustainability, January 2015.

# Proposals submitted for follow-on research:

 We are planning an August 2015 submission to NSF's Advancements in Bioinformatics panel based on the models being developed in this workshop. PIs and co-PIs would be Leslie Ries, Dan Sheldon, and Elise Zipkin Meetings or workshops initialized as a result of SESYNC synthesis activity:

# Students involved with project and/or trained:

1. Tyson Wepprich is a graduate student that has become a major contributor to one of our subgroups on mechanistic modeling. We anticipate him being the lead on at least one paper emerging from this effort.

# Stories related to your synthesis efforts:

A monitoring program director heard about our workshop and really wanted to attend since he had no idea how to analyze his data. He did attend (at his own expense with some support from me) and had this to say: "Hi Leslie, I just wanted to again say thank you for including me and plugging me into the Models for Citizen Science Insect Survey Data workshop. It was one of the most productive meetings I've ever attended, and I feel great about establishing wonderful collaborations to try to move science forward. I'm really looking forward to the next meeting in May(?). Cheers, Jeff"

# Comments:

Our second workshop (December 2014) really launched the main analysis efforts while the first workshop (May 2014) really just outlined our goals. We anticipate several products emerging throughout this year and into the next.

# Predicting Conflicts; PIs: Neil Carter and Adrian Treves Project Title: New tools to predict and prevent human-wildlife conflicts

# **Publications:**

# Book chapter, in press:

1. Treves, A., C. Browne- Nuñez, J. Karlsson Frank, L. Naughton-Treves, N. Rust, and Z. Voyles. in press. Estimating wolf-poaching opportunity and potential. in Conservation Criminology (Gore ML ed.), Wiley Publications, New York.

From Local to Global; PIs: Klaus Hubacek and Kuishuang Feng Project Title: Linking local consumption to global environmental impacts

#### **Publications:**

#### Published:

1. Hubacek, K., Feng, K., Minx, J.C., Pfister, S., Zhou, N., (2014). Teleconnecting Consumption to Environmental Impacts at Multiple Spatial Scales. Journal of Industrial Ecology 18, 7-9.

# Special issue:

2. Journal of Industrial Ecology Special Issue: Linking Local Consumption to Global Impacts (<u>http://jie.yale.edu/jie-cfp-local-global</u>). Deadline April 15, 2015.

#### Conference presentations and invited talks:

- 1. Hubacek and Feng: "Teleconnecting human activities to environmental impacts at multiple spatial scales". Invited presentation at the Annual Conference of the American Meteorological Society. Phoenix, AZ, 2015.
- 2. Hubacek and Feng: "Data Issues and Preliminary Results of Income Inequality and Environment Inequality". Invited presentation at the DECPI Global Poverty and Inequality Measurement Workshop. The World Bank, November 20, 2014
- 3. Feng and Hubacek: "Linking local consumption to water use at multiple spatial scales", Department of Geography, University of Delaware, Newark, Delarware, USA, Oct 10, 2014.
- Hubacek, K., Feng, K., Minx, J.C., Pfister, S., Zhou, N., (2014). Teleconnecting Consumption to Environmental Impacts at Multiple Spatial Scales, the 2014 Annual Meeting of the Association of American Geographers (AAG), 2014, Tampa, Florida.

# WORKSHOPS

Citizen Science & Butterfly Monitoring; PIs: Leslie Ries Project Title: Citizens science, butterfly monitoring and cyberinfrastructure

# **Publications:**

# In press or published:

- 1. Ries, L. and K. Oberhauser. In press. A Citizen-Army for Science: Quantifying the Contributions of Citizen Scientists to our Understanding of Monarch Butterfly Biology. *Bioscience*.
- 2. Diamond, SE and Cayton, H and Wepprich, T and Jenkins, CN and Dunn, RR and Haddad, NM and Ries, Leslie (2014). Unexpected phenological responses of butterflies to the interaction of urbanization and geographic temperature. *Ecology* 95:2613-2621.
- Diffendorfer, Jay E. and Loomis, John B. and Ries, Leslie and Oberhauser, Karen and Lopez-Hoffman, Laura and Semmens, Darius and Semmens, Brice and Butterfield, Bruce and Bagstad, Ken and Goldstein, Josh and Wiederholt, Ruscena and Mattsson, Brady and Thogmartin, Wayne E. (2013). National valuation of monarch butterflies indicates an untapped potential for incentive-based conservation. *Conservation Letters* 7:253-262.

# Manuscripts in revision or in review:

4. Lessig, H. N.M. Haddad, K. Gross, S.E. Diamond, and L. Ries. In review. Do growing degree days predict phenology across butterflies? *Ecology Letters*.

#### Book chapters:

- Ries, L., K. Oberhauser, D. Taron, E. Rendon-Salinas. In press. Connecting eastern monarch population dynamics across their migratory cycle. Invited book chapter in (K. Oberhauser, ed.) Monarchs in a changing world: Biology and conservation of an iconic insect. Cornell University Press. Ithaca, NY.
- Oberhauser, K. L. Ries S. Altizer, R. Betalden, J. Ekstrum, M. Garland, E. Howard, S. Jepsen, J. Lovett, M. Monroe, G. Morris, E. Rendon, R. RuBino, A. Ryan, C. Taylor, R. Trevino, F. Villablance, D. Walton. In press. Citizen scientists and an iconic insect: 70 years and counting. Invited book chapter in (K. Oberhauser, ed.) Monarchs in a changing world: Biology and conservation of an iconic insect. Cornell University Press. Ithaca, NY.

# **Presentations:**

- 1. Entomological Society of America. Nov. 2014. Conservation and collaboration: The monarch joint venture and monarch citizen science. (Symposium, Invited speaker)
- 2. Entomological Society of America. Nov. 2014. A citizen-army for science: Quantifying the contributions of citizen scientists to our understanding of monarch biology. (Symposium, Invited speaker)
- 3. Taxonomic Database Working Group Conference, Jönköping, Sweden. Oct 2014. Citizen science: a growing approach to biodiversity monitoring. (Symposium, Invited speaker)

#### Proposals submitted for follow-on research:

- 2015-2016. United States Geological Survey\*. Building historical databases for butterfly monitoring and milkweed herbarium data to support research on monarch population trends and other butterfly pollinators \$37,501 (PI)
- 2015-2016. United States Geological Survey\*. Mobilizing data from the North American Butterfly Association's multiple monitoring programs: critical data to understand trends in monarchs and other butterfly pollinators \$38,000 (co-PI)
- \*Proposals were selected for funding, awaiting final budget approval

#### Students involved with project and/or trained:

1. Ashlee Malone - (Undergraduate, Biology, Univ. of MD) - helped compile databases on butterfly life history traits

#### Data, software, tools, and websites produced from synthesis efforts:

- 1. PollardBase a system for regional butterfly monitoring networks to enter, manage and (in the future) visualize and share data <u>http://mp.butterfliesandmoths.org/pollardbase</u>
- 2. Butterfly data house (still in development) a system to manage, share and visualize NABA butterfly data

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

Attended butterfly monitoring volunteer workshops and shared the goals of the project. Many people excited to know their data are finally going to be used and that they will finally have access to it.

#### Publicity in popular press:

I know that the Ohio phenology got picked up by some local papers - but I could only find press releases, etc. on line.

# Learning Exchanges; PIs: Kiki Jenkins and S. Hoyt Peckham Project Title: Learning exchanges for conservation: An examination of lessons learned

## **Publications:**

Expected future publications in *Marine Policy Special Section* on Fisher Learning Exchanges (The Editors of Marine Policy have approved of our special issue proposal and invited us to submit these papers for review):

- 1. Thompson, K., Peckham, H., and Jenkins, L.D. Key characteristics of successful fisher learning exchanges.
- 2. Jenkins, L.D., Peckham, H., and Thompson, K. Fisher learning exchanges for conservation: History and scope.
- 3. Jones, B., Peabody, S., and Harris, A. The use of fisher exchanges to build support for community-based fisheries management: a case study from southwest Madagascar.
- 4. McConney, P., Pereira Medeiros, R., and Catiana Foppa, C. Exchanges and networks transform adaptive capacity: Caribbean and Brazilian perspectives.
- 5. Bretos, F., Moncada, F., Peckham, H., and Diego, A. Fishers Learning Exchanges and Sea Turtle Conservation: An effort between Mexico, Cuba and the US to engage Cuban coastal communities in non-consumptive alternative behaviors.
- 6. Victor, S. Learning exchanges leverage wide range of support for conservation and management in Micronesia.

The Guidebook on lessons learned about exchanges is still being produced. Hoyt and Nicholas Pilcher have both expressed continued commitment to this, but unexpected circumstances in their professional and personal lives have sidelined the project for now.

# **Presentations:**

- 1. Thompson, K., Peckham, H., and Jenkins, L.D. Key characteristics of successful fisher learning exchanges. International Sea Turtle Symposium, Dalaman, Muğla, Turkey, April 2015. (This has already been accepted for an oral presentation at the conference).
- 2. Bretos, F. 2013. Fishermen Learning Exchanges for Conservation: An Examination of Lessons Learned. Gulf and Caribbean Fisheries Institute Conference. *In:* Proceedings of the Sixty-sixth Annual Gulf and Caribbean Fisheries Conference.
- 3. Jenkins, L.D., Peckham, H., and Thompson, K. 2014. International Fisher Learning Exchanges for Conservation: Examining Lessons Learned. *International Sea Turtle Symposium, New Orleans, LA, April 2014.*
- 4. Thompson, K. 2014. Informational Video on Fisher Learning Exchanges for Conservation. *International Sea Turtle Symposium, New Orleans, LA, April 2014.*

#### Proposals for follow-on research:

This past summer, we submitted a proposal to the Walton Foundation to fund phase two of the project. The program officers requested a call with us to discuss it further and expressed an interest in the work. However, the Walton Foundation recently underwent an administrative change and is undertaking strategic planning. During the course of this process, they are not adding new projects to the portfolio. The program officers gave us suggestions of other foundations that might be interested, which we are pursuing. They also requested that we keep them up to date with the project in hopes that their ability to fund it will change in the future.

## **Collaborations:**

- 1. We are in the process of putting together a special issue in Marine Policy on fisher learning exchanges, the topic of the FLExCELL workshop. The special issue will include the publication titles listed above written by FLExCELL attendees and new collaborators. The idea for the special issue originated at the FLExCELL workshop.
- 2. The community of fishers, practitioners, and academics formed at FLExCELL continues to exist today and exchanges news and research regarding fisher learning exchanges.

#### Other (media/websites/educational toolkits):

- 1. Informational video on fisher learning exchanges for conservation by K Thompson. Presented at International Sea Turtle Symposium in New Orleans, LA, April 2014.
- 2. Through a pre-workshop questionnaire, information regarding best practices of fisher learning exchanges was collected from workshop participants. During the workshop, interviews were conducted and focus groups were held in order to gather information about fisher learning exchange best practices and to devise a list of next steps for the community of researchers, practitioners, and fishermen who were present at the workshop. Participants also developed an outline of a guidebook containing lessons learned of exchanges.

Using Human Interactions with Games; PIs: Robert Costanza and Lisa Waigner Project Title: Advancing tools and visualization techniques for representing modeled ecosystem service outcomes in simulated multi-player game environments

#### **Publications:**

1. Costanza, R et al (2014). Simulation games that integrate research, entertainment, and learning around ecosystem services. *Ecosystem services* 10 195-201. doi:10.1016/j.ecoser.2014.10.001

#### Follow-on research:

- 1. Proposal for \$3Million+ to the Australian Research Council submitted last year, didn't make it but was in the top 10% of those that didn't make. This is a resubmission. I think it has a good chance. It benefited a lot from the workshop.
- 2. Notification of Intent for a Center of Excellence that involves SESYNC as a potential partner more on this later if it progresses.

Linking Science to Change; PIs: Thaddeus Miller and Lennart Olsson Project Title: Linking socio-environmental science to socio-environmental change

#### **Publications:**

 Miller, TR and Wiek, A and Sarewitz, D and Robinson, J and Olsson, L and Kriebel, D and Loorbach, D (2013). The future of sustainability science: a solutions-oriented research agenda. *Sustainability Science*. Volume 9, Issue 2, pp 239-246. DOI 10.1007/s11625-013-0224-6.

Globalizing Rural Land Use Change; PIs: Jasper Van Vliet and Erle Ellis Project Title: Globalizing our understanding of land-use change

#### **Publications:**

1. Ellis, E. and van Vliet, J. Under review. Globalizing our understanding of land use changes. *Progress in Physical Geography.* 

#### **Presentations:**

- 1. During the Global Land Project's Open Science Meeting in Berlin, March 19-21, 2014 a follow-on workshop was organized by Nick Magliocca (Postdoctoral Fellow) and Jasper van Vliet (PI), in which the results of this workshop were presented.
- 2. The GLOBE project (UMBC) was presented during this workshop and several researchers indicated that they would introduce their meta-studies in the GLOBE system to further their effort to synthesize land change knowledge.

#### Student training/involvement:

1. Bianka Buchner has started a PhD project at VU University Amsterdam in which she will build on the results of this workshop.

#### Data, software, tools, and websites produced from synthesis efforts:

Already included case studies and meta-studies entered into the GLOBE online collaboration system (http://globe.umbc.edu)

#### Stories related to your synthesis efforts:

We learned a great deal about the challenges of moving the synthesis work across the boundary from empirical strategies to modeling - and I think this was very enlightening, especially as the team began to work together across the boundary, realizing that both "sides" depended equally on each other, even though our data needs and intended outputs were so different. I think all of came away with a stronger understanding of how to work across the empirical theoretical divide in our discipline, and a will to make this happen much more often!

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

Our conclusions on global land use change synthesis strategies have been included in the outreach and research efforts of the Global Land Project.

#### Comments:

A great place to conduct synthesis- and an inspiration to do more!

# Social Media & Socio-Environmental Systems; PIs: Andrew Crooks and Nicholas Magliocca

Project Title: How can social media can be used to explore coupled socio-environmental systems?

#### **Publications:**

1. Article for submission to Ecology and Society is in preparation.

#### Proposals submitted for follow-on research:

- 1. Funded "The value of water quality to lake recreation: Evidence from geotagged social media". Bonnie Keeler and Spencer Wood, SESYNC.
- Funded "The Socio-Environmental Data Explorer (SEDE): Integrating Social Media and Environmental Data in CyberGIS to Explore Environmental Hazard Risk Perception". V. Kelly Turner and Eric Shook, SESYNC.

#### Stories related to your synthesis efforts:

The workshop brought a diverse group of researchers together with varying degrees of expertise in using social media data for environmental research. Those that were not experts on the data side all expressed how excited they were to learn about the potential applications of social media data and the various techniques used collect and analyze targeted data. On the other side, the social media data experts were enthusiastic about the potential to bring social media data analysis into a new application area.

# Drought Adaptations in Kenya; PIs: Datu Buyung Agusdinata

Project Title: Workshop for a modeling framework development for addressing drought impacts in Kenya: dynamic systems and adaptation policies

#### **Presentations:**

1. Presentation to the Humphrey School of Public Affairs, University of Minnesota 2. Presentation to the School of Sustainability, Arizona State University.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

1. A follow up visit and meeting with the community of the University of Nairobi Kenya including the Center for Sustainable Dryland Ecosystems and Societies

#### Students involved with project and/or trained:

1. Post-doc Ali Mirchi at the Department of Civil and Environmental Engineering at the Michigan Technological University

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

- 1. Engagement with the Agriculture and Food Security unit at USAID. Contact person: Moffatt Ngugi.
- 2. Engagement with the NGO World Vision International. Contact person: Niber Baba Tierto

3. Engagement with the United Nations Environment Programme (UNEP). Contact person: Keith Alverson.

#### Comments:

- 1. Comment from Claire Nelson, a participant representing The Futures Forum, Development Foresight Institute: "The modeling approach developed in the workshop can be applied to the socio-environmental problems in the Caribbean region."
- 2. Comment from Ana Prados, a participant representing the NASA Goddard Space Flight Center: " I can see how I can contribute my expertise in remote sensing to the drought adaptation model, which I think can make an impact in informing better decisions."

# FOUNDATIONS

Sociological Perspectives in Environmental Governance; PIs: Dana Fisher and Carmen Sirianni

Project Title: Sociological Perspectives on Non-State Actors in Environmental Governance

#### **Publications:**

1. Book proposal for project with Carmen Sirianni and Kenneth T. Andrews, which is the product of our foundations Workshop, is under review currently.

Limits of Environmental Governance; PIs: Arun Agrawal and Kerry Waylen Project Title: The Limits of Environmental Governance

#### **Publications:**

#### In progress:

- 1. One paper idea, led by Don Nelson, with co-authors by Beatrice Crona and myself, plans to use three aquatic case studies to point out the problems that "institutional fit" can change for a lot of reasons in both environmental and societal components of socio-ecological systems.
- 2. The other paper, led by Kathleen Buckingham, Drew Gerkey and I think Maria Fernandez-Gimenez, which focuses more on the concept of 'interplay' between governance levels, again building on a unique combination of empirical evidence linked to prior work by each of the co-authors. I will write to all the (co)authors and ask them to ensure that if and when these papers are submitted, they acknowledge your support using the phrase you've provided below.

#### Postdocs and students involved:

- 1. Drew Gerkey (postdoc)
- 2. Julio Postigo (postdoc)
- 3. Kathleen Buckingham had just finished her PhD

#### Engagement and/or exchange with knowledge users:

1. Some of the participants also have or have had experience of working in non-academic contexts (I'd put myself in that box, to a limited extent, but more so other participants such as Rosie

Cooney). Our second workshop involved people who primarily see themselves as nonacademics. If we do manage to publish academic papers on this, I would intend to develop shorter briefing note in non-academic language/ publish the work on blogs, twitter etc.

2. The thinking I did on this subject certainly informed and enriched my other work, and I am sure the same is true for other participants, though I don't have any individual formal papers or initiatives I can confidently claim are definitely and mostly the result of this initiative. For example, I have paper in press at in the Environmental Planning and Governance journal: I haven't cited SESYNC in the acknowledgements because the arguments and the funding for the research arise from a completely separate project, however my perspective on the subject (and my ability to write it up) undoubtedly benefited from my SESYNC experiences.

Ecological vs. Political Time Scales; PIs: Alan Hastings and Lynn Maguire Project Title: Ecological vs. Political Time Scales for Expected Outcomes to Restoration

#### **Publications:**

#### Under review:

 Robyn S. Wilson, David J. Hardisty, Rebecca S. Epanchin-Niell, Michael C. Runge, Kathryn L. Cottingham, Dean L. Urban, Lynn A. Maguire, Alan Hastings, Peter J. Mumby, Debra P.C. Peters. Timescale mismatches bedevil environmental management, but behavioral interventions provide new solutions. *PNAS*.

#### In prep:

- 2. Becky Epanchin-Neill, Alan Hastings and Kathy Cottingham are working on an invasive species paper tentatively titled "Tools from behavioral science could help manage invasive species."
- 3. Dave Hardisty, Mike Runge and Lynn Maguire are working on a "Discounting environmental consequences" paper.

# **Presentations:**

1. Dave Hardisty from the University of British Columbia Business School, presented our project at the annual meeting of the Center for Research on Environmental Decisions (CRED) in May 2014.

Beyond Traditional Roles; PIs: Susan Clayton and Patrick Devine-Wright Project Title: Beyond Traditional Roles: The Contribution of Psychology to Environmental Sustainability

# **Publications:**

# Accepted:

1. Susan Clayton, Patrick Devine-Wright, Paul Stern, Lorraine Whitmarsh, Amanda Carrico, Linda Steg, Janet Swim, and Mirilia Bonnes. Psychological Research and Global Climate Change. *Nature Climate Change*. 2014.

# Submitted:
Susan Clayton, Patrick Devine-Wright, Janet Swim, Mirilia Bonnes, Linda Steg, Lorraine Whitmarsh, Amanda Carrico. Psychology and Environmental Challenges: Opportunities and Obligations. *American Psychologist*.

#### Comments:

There are no other concrete outputs that I am aware of. However, indirectly I've been much more aware of the need to engage with non-psychologists. I (Clayton) was elected president-elect of the Society for the Psychological Study of Social Issues (SPSSI) last summer and I'm planning on making outreach to non psychologists one of my presidential initiatives. I have recruited Amanda Carrico, one of the other workshop participants, to be program chair for the SPSSI part of the 2016 APA convention and hope to stress interdisciplinary perspectives on environmental issues. I will be speaking next month to the Commission for Social Development at the UN on issues related to the impacts of climate change on children, and in general have become more mindful about the ways in which to translate psychological findings to the public.

# Food Security, Equity & Ecological Sustainability; PIs: M. Jahi Chappell and Hannah Wittman

Food Security, Equity and Ecological Sustainability: A multi-indicator, process oriented framework for food systems research

#### **Publications:**

#### In press or published:

- 1. Weiler, A. M., Hergesheimer, C., Brisbois, B., Wittman, H., Yassi, A., & Spiegel, J. M. (2014). Food sovereignty, food security and health equity: a meta-narrative mapping exercise. Health Policy and Planning. doi:10.1093/heapol/czu109
- 2. Jones AD, Shrinivas A, and Bezner Kerr R. 2014. Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data. Food Policy 46: 1–12.
- Abson, D., Sherren, K., & Fischer, J. (2015). The resilience of agricultural landscapes characterized by land sparing versus land sharing. In S. Gardner, R. Hails, & S. Ramsden (Eds.), Agriculture Resilience: perspectives from ecology and economics. Cambridge University Press.
- Abson, D., von Wehrden, H., Baumgärtner, S., Fischer, J., Hanspach, J., Härdtle, W., ... Walmsley, D. (2014). Ecosystem services as a boundary object for sustainability. Ecological Economics, 103 (7), 29-37.
- Abson, D., von Wehrden, H., Baumgärtner, S., Fischer, J., Hanspach, J., Härdtle, W., ... Walmsley, D. (2014). Ecosystem services as a boundary object for sustainability. Ecological Economics, 103 (7), 29-37.
- Fischer, J., Abson, D., Butsic, V., Chappell, M. J., Ekroos, J., Hanspach, J., ... von Wehrden, H. (2014). Land sparing versus land sharing: moving forward. Conservation Letters, 7 (3), 149-157.
- 7. Fischer, J., Sherren, K., & Hanspach, J. (2014). Place, case and process: Applying ecology to sustainable development. Basic and Applied Ecology, 15 (3), 187-193.
- Hanspach, J., Hartel, T., Milcu, A. I., Mikulcak, F., Dorresteijn, I., Loos, J., ... Fischer, J. (2014). A holistic approach to studying social-ecological systems and its application to Southern Transylvania. Ecology and Society, 19 (4), [32].

 Loos, J., Abson, D., Chappell, M. J., Hanspach, J., Mikulcak, F., Tichit, M., & Fischer, J. (2014). Putting meaning back into "sustainable intensification". Frontiers in Ecology and the Environment, 12 (6).

#### Submitted:

- Wittman, H., D. Abson, R. Bezner Kerr, J. Blesh, M. Chappell, J. Hanspach, I. Perfecto, J. Fischer. A social-ecological perspective on harmonizing food security and biodiversity conservation. Submitted to Frontiers in Ecology and the Environment, January 2015.
- 11. Blesh, J and Wittman, H. "Brasilience": Assessing resilience in land reform settlements in the Brazilian Cerrado. Submitted to Human Ecology. Jan 2015.
- 12. Wittman, H and J Blesh. Food Sovereignty and Fome Zero: connecting public food procurement to sustainable rural development in Brazil. Submitted to Journal of Agrarian Change August 2014 (currently pending revisions).
- 13. Graub, Chappell, Wittman, Bezner Kerr et al. The State of Family Farmers in the World. Revised version Submitted to World Development in January 2015.

#### Student and Post-doc involvement:

- 1. Jan Hanspauch is a PhD student in Joern Fisher's lab
- 2. Dave Abson is a post-doc

#### Follow-on funding/grants submitted:

 Blesh (PI) and Wittman (Co-I) to NSF Coupled Human-Natural Systems (submitted November 2014): A comparative analysis of social-ecological linkages in diversified agricultural landscapes of Brazil

Managing Recreational Fisheries; PIs: Mike Wilberg, Robert Arlinghaus, and Olaf Jensen Managing recreational fisheries as complex adaptive social-ecological systems

#### **Publications:**

#### In revision:

1. Ward, Hillary – in revision in *Fisheries*.

#### **Collaborations:**

The workshop has led to reinforced collaborations among subsets of the workshop members, culminating in the shaping or reformulation of other ongoing publications that were started before the SESYNC project kicked off. I know of two papers (one led by Hillary Ward from Canada) and one by myself that was inspired by the SESYNC project and the framework developed.

#### Meetings planned/developed:

As a result of the meeting, a subteam also held another workshop in Colorado on "Environmental Values" led by Manfredo.

#### Follow-on funding:

I have been involved in a pre-proposal for Horizon 2020 in which fisheries are conceptualized as complex adaptive systems. The SESYNC output certainly helped in shaping the proposal.

## FELLOWS

## Sabbatical/Visiting Scholar

Michael Perring Publications:

1. I have co-authored a paper (led by Laura Martin) on conservation opportunities across the world's anthromes – see Diversity and Distributions, 20, 745 – 755.

#### Other:

- 2. Ideas that were discussed during my time at SESYNC also appeared in the paper by Hobbs et al. 2014 in *Frontiers in Ecology and Environment* 12, 557 564.
- 3. I am about (i.e. by the end of the month) to submit a paper for the ESA Centennial (to Ecosphere) on the challenges ahead for restoration ecology. A section of this paper is focused on coupled socio-ecological / socio-environmental systems again, ideas that were discussed at SESYNC will feature in this paper and having the opportunity to meet with the SESYNC post-docs in particular was extremely useful for this framing.

#### **Collaborations:**

While based at SESYNC I also visited the Smithsonian Environmental Research Centre and met John Parker. He has now joined TreeDivNet (www.treedivnet.ugent.be; of which Ridgefield (the long term experiment in WA, Australia)) was already part. This led to a workshop at sDiv / iDiv in Leipzig in March last year which has now led to at least two papers – one submitted on the rationale behind, and early results from, TreeDivNet; and one looking in more detail at survival in the different TreeDivNet experiments and whether diversity contributes to differential survival (led by Simon Bilodeau Gauthier, in draft).

#### Proposals for follow-on funding:

- 1. I contributed to a grant application for a workshop proposal on marine anthromes to SESYNC (ultimately unsuccessful but with helpful reviews) with Erle Ellis, Ben Halpern, Aaron Ellison and Peter Bridgewater.
- 2. Unfortunately, seed funding for the proposal to develop a global evidence base for managing ecological novelty (that I developed with Erle while visiting SESYNC and in the months afterwards) was unsuccessful.

#### Other:

On a side note, and not sure this counts as an output but was a 'shout-out' for you, I reviewed Human Dimensions in Ecological Restoration (SER Edited book by Egan et al. 2011) for Ecological Management

and Restoration. I ended the review by noting the research being pursued at SESYNC. See doi: 10.1111/emr.12143

#### Vicenç Acuña Publications:

Acuña V, et al (2014). Conservation: Why Should We Care About Temporary Waterways? *Science*. 343(6175): 1080-1081. DOI: 10.1126/science.1246666

#### Thomas Hobbs Publications:

#### Books:

- 1. N. T. Hobbs and M. B. Hooten. Bayesian models: A statistical primer for ecologists. Princeton University Press, Princeton New Jersey, USA. In press.
- N. T. Hobbs, C. Geremia, J. Treanor, R. Wallen, P. J. White, M. B. Hooten, and J. C. Rhyan. Statespace modeling to support management of brucellosis in the Yellowstone bison population. Ecological Monographs. In revision.

#### **Presentations:**

- 1. Why bother with Bayes? Examples from population ecology. Dartmouth College, November 14, 2014.
- 2. Why bother with Bayes? Examples from population ecology. University of Maine, November 17, 2014.

### Dana Fisher

#### **Publications:**

#### Book:

 Fisher, Dana R., Erika S. Svendsen, and James J.T. Connolly. 2015. Urban Environmental Stewardship and Civic Engagement: How Planting Trees Strengthens the Roots of Democracy. Routledge Press.

#### **Presentations:**

- Urban Environmental Stewardship and Civic Engagement: how planting trees strengthens the roots of democracy." 2014. Séminaire Ladyss Paris-7, University Paris Diderot, Paris, France. October.
- 2. Urban Environmental Stewardship and Civic Engagement: how planting trees strengthens the roots of democracy." 2015. Séminaire Faculté de Géographie, University of Strasbourg, Strasbourg, France. January.

#### Stories related to your synthesis efforts:

Spending one day a week at SESYNC gave me time to begin writing the book. It was wonderful sitting in the common area, talking with Post-Docs and visitors at SESYNC about their work and brainstorming my work.

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

The findings from this book have been presented to colleagues at NOAA and at the James L. Knight Foundation.

#### Publicity in popular press:

- 1. Fisher, Dana R. 2014. "Plant Trees for a Better Democracy." Baltimore Sun. 4 November 2014.
- 2. I am currently writing another OpEd for the Chronicle of Philanthropy that discusses the findings of this research project.

## J. Baird Callicott

#### Publications:

#### Accepted/forthcoming:

- 1. J. Baird Callicott. "What Good Is It, Anyway?" in the *Routledge Handbook of Biodiversity*, edited by Justin Garson, Anya Plutinski, and Sahotra Sarkar. Routledge, an imprimatur of Taylor and Francis, Oxford. (accepted Jan 2015).
- 2. Margaret Palmer and J. B. Ruhl, Bringing coherence to restoration science and law in support of ecological infrastructure (invited contribution to *Frontiers in Ecology and the Environment* 1915-2015 ESA centennial issue to be submitted January 2015).
- 3. J. Baird Callicott, Wetlands. In Benjamin Hale and Andrew Light, eds., *The Routledge Companion to Environmental Ethics*. London: Taylor & Francis/Routledge (forthcoming).

#### Submitted:

 Katherine Suding, Eric Higgs, Margaret Palmer, J. Baird Callicott, Christopher B. Anderson, Matthew Baker, John J. Gutrich, Kelly Hondula, Matthew C. LeFevor, Brendon M. H. Larson, Alan Randall, J. B. Ruhl, Katrina Z. S. Schwartz, Seeing the forest and the trees: comprehensive ecological restoration (submitted to *Science* December 5, 2014)

#### In progress:

- 5. J. Baird Callicott and possible co-authors, Linking ecological restoration and ecosystem services: philosophical perspectives (in progress).
- 6. Katrina Schwartz, Matthew LeFevor, Christopher Anderson, The role of ecosystem services in political ecology (in progress).
- 7. Margaret Palmer, Eric Higgs, and Matthew Baker, Refining the ecological principles of ecological restoration (in progress).
- 8. Brendon Larson and possible co-authors, Guidelines for the utilization of non-native species in ecological restoration (in progress.)

#### Synthesis Paper:

Katherine Suding, Eric Higgs, Margaret Palmer, J. Baird Callicott, Christopher B. Anderson, Matthew Baker, John J. Gutrich, Kelly Hondula, Matthew C. LeFevor, Brendon M. H. Larson, Alan Randall, J. B. Ruhl, Katrina Z. S. Schwartz, Guidelines for Using Ecosystem Services in Comprehensive Ecological Restoration: Synthesizing our Understanding of Limitations and Proposing Potential Solutions from Scientific and Humanities Perspectives.

#### **Presentations:**

- 1. J. Baird Callicott, SESYNC seminar PowerPoint presentation, September 9, 2014: Environmental Philosophy/Ethics: An Overview.
- 2. J. Baird Callicott, Café Scientifique/41 West PowerPoint presentation, October 30, 2014: Should Endangered Species Have Standing? Toward Legal Rights for Listed Species.
- 3. J. Baird Callicott, Bovay Lecture, Texas A & M University, November 12, 2014: The Land Ethic and the Earth Ethic: Aldo Leopold in a Time of Global Climate Change.
- 4. J. Baird Callicott, PowerPoint Presentation in the Philosophy Lecture Series, University of Richmond: Thinking Like a Planet: The Land Ethic and the Earth Ethic.

#### Student training/involvement in project:

- 1. Consulted with SESYNC post-doc Neil Carter on his coexistence with big carnivore project and offered editorial advice regarding his co-authored paper, The keys to coexistence: realizing the potential for integrating large carnivores into multi-use landscapes.
- 2. Consulted with SESYNC post-doc Mary Collins about her project on environmental justice.
- 3. One SESYNC post-doc, Mathew LeFevor and one research assistant, Kelly Hondula are included as members of my working group.
- 4. I introduced one of my graduate students at UNT, Kelli Barr, to Linwood Pendleton, a SESYNC project director in connection with her dissertation research.

#### Matthew Baker

#### Publications (submitted while at SESYNC):

#### In review:

- 1. Suding, K, E Higgs, M Palmer, JB Callicott, CB Anderson, ME Baker, JJ Gutrich, KL Hondula, MC LaFevor, BMH Larson, A Randall, JB Ruhl, KZS Schwartz. (in review). Seeing the forest and the trees: comprehensive ecological restoration. Science.
- 2. Baker, ME, ML Schley, and JO Sexton. (in review). Impacts of expanding impervious surface on specific conductance in urbanizing streams. Proceedings of the Natural Academy of Science.
- 3. Utz, R, K Hopkins, D Booth, R Hawley, ME Baker, L Beesley, M Freeman, and K Jones. (in review). Do specific natural watershed and channel attributes confer ecological resistance to urbanization in streams? Freshwater Science.

#### In prep:

I developed a new collaboration with Margaret Palmer and Ben Koch related to this article:

4. Koch, BJ, CM Febria, RM Cooke, JD Hosen, ME Baker, MA Palmer. (in prep). Suburban watershed nitrogen retention: estimating the effectiveness of stormwater management structures. Elementa.

As part of my work on a mountaintop mining case, I have developed the following publication, which has yet to be submitted:

5. Baker, ME. (in prep) Some observations regarding the causal consequences of mountaintop mining. Environmental Toxicology and Chemistry.

#### New collaborations:

- 1. I was able to engage with members of the Baltimore Ecosystem Study and an NGO working group organized by Baltimore Greenspace regarding community restoration in Baltimore's forest patches. There was a surprising amount of synergy in these simultaneous interactions.
- 2. I also began planning new collaborations with Dr. Sean Smith (U. Maine) and Dr. Stu Schwartz (UMBC).
- 3. I enjoyed interactions with several SESYNC post docs regarding their projects.

#### Science Communication Fellow

#### Lisa Palmer Publications:

#### Journal articles:

- 1. Palmer, Lisa. A new climate for grazing livestock. *Nature Climate Change*. 4 (5), 321-323. <u>http://www.nature.com/nclimate/journal/v4/n5/full/nclimate2215.html</u>
- 2. Palmer, Lisa. A profile on the work of the International Center for Tropical Agriculture (CIAT). *Nature*.
- Palmer, Lisa. The next water cycle. Nature Climate Change. 4, 949–950 (2014) doi:10.1038/nclimate2420 Published online 29 October 2014. <u>http://www.nature.com/nclimate/journal/v4/n11/full/nclimate2420.html?WT.ec\_id=NCLI</u> <u>MATE-201411</u>

#### Book:

I have a book proposal winging its way around New York City's publishing houses called Hot, Hungry Planet: Dispatches on the solutions to feeding the world. I may hear as early as tomorrow if it is accepted. In the book proposal I credit SESYNC and research teams feature prominently. I have already completed a few chapters and hope to finish most of the book by the time I return to SESYNC. The book has interest from academic titles like Oxford Press and Palgrave Macmillan. In the book I discuss the interdisciplinary landscape approach to agriculture as well as feature the work of Paolo's research team, the Matthews/Poff team, etc. The book is targeted to the educated public as well as academics, development and NGOs.

#### Online newspapers/magazines:

- 4. *Forthcoming*: Yale Environment 360 Climate-smart Agriculture. The article features a multidisciplinary approach to agriculture while also arguing that a more sustainable solution is needed and the analysis supports a landscape approach to management involving not only ag but also ecology, ecosystems management, policy, natural resources management, etc.
- The Guardian (2015). Can a new form of accounting save animals from extinction? 13 Jan 2015. <u>http://www.theguardian.com/sustainable-business/2015/jan/13/environment-naturalcapital-accounting-animal-nature-business</u>

- The Guardian (2015). Can a new form of accounting save animals from extinction? 13 Jan 2015. <u>http://www.theguardian.com/sustainable-business/2015/jan/13/environment-naturalcapital-accounting-animal-nature-business</u>
- Slate (2014). Famine Is a Feminist Issue: To feed the world, start by teaching girls to read. April 2014.<u>http://www.slate.com/articles/health\_and\_science/feed\_the\_world/2014/04/educate\_w\_omen\_and\_save\_babies\_how\_to\_control\_population\_and\_end\_hunger.html</u>
- Yale360 online. How weeds could help feed billions in a warming world. 5 June 2014. <u>http://e360.yale.edu/feature/how\_weeds\_could\_help\_feed\_billions\_in\_a\_warming\_worl</u> <u>d/2772/</u>
- 9. *Future Food 2050* (2014). The brave new world of meat alternatives. Article in the online publishing initiative. <u>http://futurefood2050.com/the-brave-new-world-of-meat-alternatives/</u>
- 10. *Future Food 2050* (2014). Turning yeast into sustainable fish food. 20 Oct 2014. Article in the online publishing initiative. <u>http://futurefood2050.com/turning-yeast-into-sustainable-fish-food/</u>
- 11. *Future Food 2050* (2014). The politics of food technology innovation for Africa. 16 July 2014. Article in the online publishing initiative. <u>http://futurefood2050.com/the-politics-of-food-technology-innovation-for-africa/</u>
- 12. *Future Food 2050* (2014). Innovative technology for global food waste solutions. 18 June 2014. Article in the online publishing initiative. <u>http://futurefood2050.com/innovative-technology-for-global-food-waste-solutions/</u>
- 13. *GreenBiz* (20140. Why cows, crops and timber thrive in the pastures of Colombia. 28 March 2014. <u>http://www.greenbiz.com/blog/2014/03/28/cows-crops-timber-thrive</u>
- 14. *New Security Beat* (2014). Can Ecologists and Engineers Work Together to Harness Water For The Future? 25 Nov 2014. <u>http://www.newsecuritybeat.org/2014/11/ecologists-engineers-</u> work-harness-water-future/

#### Blogs:

- 1. SESYNC Blog, Matthews/Poff group, <u>https://www.sesync.org/blog/can-ecologists-engineers-</u> work-together
- 2. Baird Callicot group, https://www.sesync.org/blog/ethical-synthesis,

#### Media/publicity:

 Yale Climate Connections - Short radio show - based on interactions with SESYNC research teams. CC is carried by over 70 public radio stations nationwide. <u>http://www.yaleclimateconnections.org/2014/09/waters-flexible-future/</u> and <u>http://www.yaleclimateconnections.org/2014/09/climate-change-ethics/</u>

#### **Presentations:**

- 1. Keynote lecture at University at Buffalo, Nov. 12 included examples from SESYNC research teams.
- 2. Led panel session at Society of Environmental Journalists in New Orleans, LA, included discussion of SESYNC teams.
- Participated in panel discussion at Woodrow Wilson Center for International Scholars in Washington, DC, on environmental journalism for year ahead 2015, and discussed importance for journalists to cover inter-disciplinary approach to environmental stories. 360 people RSVP in

#### **Engagement/exchange of ideas:**

My media communications fellowship also benefitted U.S. policy. I led a private briefing on Oct. 29 for U.S. Secretary of State's director of global food security, Chris Hegadorn, with the emphasis on a multidisciplinary approach to food security issues in Latin America and the Caribbean (science, ag, policy, research, population, ngo, water resources, family planning, environment, etc) for the development of a new food security initiative to be launched in April 2015.

#### **Postdoctoral Fellows**

Judy Che-Castaldo Publications:

- 1. Salguero-Gómez, R., O.R. Jones, C.R. Archer, Y.M. Buckley, J. Che-Castaldo et al. 2015. The COMPADRE plant matrix database: An open online repository for plant demography. *Journal of Ecology* 103(1): 202-218.
- 2. Cynthia A. Wei, William R. Burnside, and Judy P. Che-Castaldo (2014). Teaching socioenvironmental synthesis with the case studies approach. *Journal of Environmental Studies and Sciences*. DOI 10.1007/s13412-014-0204-x

#### **Presentations:**

- Dec. 2014: Neel, M.C. and J.P. Che-Castaldo. Evaluating landscape-level extinction risk to inform recovery and species status assessment. USFWS Species Status Assessment Summit. Shepherdstown, WV
- 2. Aug. 2014: Neel, M.C. and H. Tumas, B. West, and J.P. Che-Castaldo. Evaluating landscape-level extinction risk: New tools for setting science-based recovery targets. Ecological Society of America Annual Meeting. Sacramento, CA
- 3. Jul. 2014: Che-Castaldo, J.P. and M.C. Neel. Assessing extinction risk based on biological traits and extrinsic threats. North American Congress for Conservation Biology. Missoula, MT

#### Datasets or tools:

1. Nov. 2014: The COMPADRE plant matrix database was published online at <a href="http://www.compadre-db.org/">http://www.compadre-db.org/</a>

#### Students trained/involved with project:

1. Fall 2013-Spring 2014: mentored University of Maryland undergraduate students Jaclyn Levine and Matt Bisk in independent research projects

#### Engagement:

- 1. Dec. 2014: Participated in the US Fish and Wildlife Service's Species Status Assessment Summit at the National Conservation Training Center, WV
- Jul. 2014: Participated in the meeting "Best Available Science and Imperiled Species Conservation: Challenges, Opportunities, and Partnerships" at Resources for the Future, Washington, DC

## Bill Burnside

## Publications:

- 1. Wei, C. A., Burnside, W. R., & Che-Castaldo, J. P. 2014. Teaching socio-environmental synthesis with the case studies approach. Journal of Environmental Studies and Sciences, 1-8.
- 2. Burnside, W.R., Erhardt, E.B., Hammond, S.T., and Brown, J.H. 2014. Rates of biotic interactions scale predictably with temperature despite variation. Oikos 123(12): 1449-1456.

## Presentations:

- 1. Burnside, W.R. The functional ecology of economic diversity? Eco\*\*2 Summit, 9/8-10/14, London School of Economics, UK
- 2. Burnside, W.R. Toward a functional ecology of livelihood diversity. Association of American Geographers, Tampa, FL, April 2014.
- Burnside, W.R. and Che-Castaldo, J. 2014. Lessons from a SESYNC Short Course on Teaching S-E Synthesis with Case Studies. In Proctor, J., Wei, C., Burnside, W.R., Montelbanco, A., and Caplow, S. 2014. Teaching about Socio-environmental Synthesis with the Case Study Approach. Association for Environmental Sciences and Studies: AESS 2014 Session Group C. Pace University, New York, NY.

#### Drew Gerkey Publications:

## Journal Articles:

- 1. Gerkey, A and Cronk, L. What is a Group? Conceptual Clarity Can Help Integrate Evolutionary and Social Scientific Research on Cooperation. *Behavioral and Brain Sciences*.
- 2. Gerkey, Drew (2013). Cooperation in Context: Public Goods Games and Post-Soviet Collectives in Kamchatka, Russia. *Current Anthropology*. 54 144--176.

## Under Review:

3. Hruschka, Daniel, Gerkey, Drew & Hadley, Drew (Under Review) "Estimating Absolute Wealth for the Study of Deprivation, Abundance and Health" Submitted to Bulletin of the World Health Organization.

## Encyclopedia Entry:

4. Gerkey, A (2013). Evolution of Kinship. Encyclopedia entry in: International Encyclopedia of the Social and Behavioral Sciences (2nd edition).

## Presentations:

## Academic Presentations:

- 1. 2015. American Association of Physical Anthropology. "Interdependence, Risk-Pooling, and Environmental Change in Arctic Subsistence Economies: Ethnographic and Experimental Evidence." St. Louis, MO. (Accepted)
- 2. 2014. American Anthropological Association. "An Eco-evolutionary Approach to Human Adaptability and Resilience." Washington, DC.

3. 2014. Northwest Evolution, Ecology, and Human Behavior Symposium. "An Eco-evolutionary Approach to Human Adaptability and Resilience." Boise State University. Boise, ID.

#### Invited Talks:

- 2015. Gund Institute for Ecological Economics, University of Vermont. "Salmon, Reindeer, and Rubles: Understanding Cooperation in a Post-Soviet Commons." Burlington, VM. (Scheduled, March 2015) 2015. University of Oregon. "Cooperation, Risk-pooling, and Interdependence in Arctic Social Networks." Eugene, OR.
- 5. 2014. Stanford University. "Making Ends Meat: Cooperation, Risk-pooling, and Interdependence in Arctic Social Networks." Palo Alto, CA.
- 6. 2014. Wild Salmon Center. "Cooperation, Institutions, and Salmon Fisheries in Kamchatka, Russia." Portland, OR.

#### Proposals submitted for follow-on research:

- 2014. Collaborative Research: Livelihoods in Indigenous Communities: Household Economies and Networks (LICHEN). PI: Kathryn Demps (Boise State). CoPIs: Drew Gerkey (Oregon State), Shauna BurnSilver (Arizona State), David Schaeffer (Arizona State), Peter Collings (Florida), John Ziker (Boise State). National Science Foundation. Arctic Social Sciences Program. Amount: \$310,932.00 (Gerkey, CoPI), ~1.5 Million (Total). Status: Under Review.
- 2014. "Discovering Yidong Xinag: Traditional Ecological Knowledge and Free Choice STEM Learning for Native American Tribes of the Oregon Coast." PI: Drew Gerkey (Oregon State). CoPI: Shawn Rowe (Oregon State). National Science Foundation. Advancing Informal STEM Learning. Amount: ~1.5 Million (Gerkey, PI). Status: Under Review.

NOTE: Both of these proposals apply methods of social network analysis that build on Gerkey's research during the SESYNC post-doc. The second proposal (Discovering Yidong Xinag) also draws inspiration from one of SESYNC's central goals: advancing inter-disciplinary synthesis to produce actionable science that addresses environmental issues. Specifically, Gerkey will collaborate with Rowe (an expert in informal STEM learning and marine science) and Wisdom of the Elders (a Portland based media and education NGO that synthesizes traditional knowledge and science education in Native communities). We aim to address the under-representation of Native Americans in STEM fields by exploring the links between traditional knowledge and STEM by focusing on the importance of relationships, cultural identity, and attachments to place that occur in "informal" learning environments.

#### Meetings or workshops initialized as a result of SESYNC synthesis activity:

- 1. Gerkey, Drew & Padmanabha, Harish. 2014. "Human Eco-Evolutionary Dynamics, Adaptive Capacity, and Resilience." SESYNC Workshop. Status: Declined.
- Colombi, Ben, Degai, Tatiana, Gerkey, Drew, & Koester, David. 2012. "Mapping Ethnographic Landscapes in Kamchatka: Participatory Mapping Workshop" Sponsors: University of Arizona & Google Earth Outreach.

#### Data, software, tools, and websites produced from synthesis efforts:

The manuscript co-authored with Hruschka and Hadley (under review at the Bulletin of the World Health Organization) presents a method for generating an absolute estimate of wealth from USAID

Demographic and Health Surveys (DHS) data on household wealth. This is a novel and useful tool because wealth is notoriously difficult to measure in developing countries, and it is most often measured by proxy, through asset inventories that differ by country. This means that wealth estimates are valid within countries, but not between countries, limiting our ability to do global analysis of linkages between poverty and well-being. Our method can be easily applied by researchers working with DHS data, and once published, we plan to make our code available to encourage its use.

My involvement in this project arose as a result of my participation in the SESYNC project on Conservation and Welfare (PIs: Brendan Fisher and Taylor Ricketts). We were grappling with the issue of generating a comparative wealth estimate, and I came across a method developed by Hruschka. After applying Hruschka's method, he and I began to discuss improvements, which we implemented along with Hadley in our manuscript. This revised tool has already become a part of the analysis for our SESYNC project.

#### Stories related to your synthesis efforts:

The opportunity to complete a post-doctoral fellowship at SESYNC was a transformative experience. I arrived with a strong background in environmental anthropology. Like SESYNC, this is an interdisciplinary field focused on human-environment interactions. However, to date my interactions across disciplinary boundaries had been primarily limited to scholarly domains. At SESYNC, I had many opportunities to engage with researchers working in more applied domains, including WWF, WCS, USAID, TNC and other governmental and non-governmental organizations. These experiences have certainly shaped the goals and methods of my research. I have a better appreciation for the unique opportunities and challenges that researchers in applied domains face, and I can more clearly see how scholarly research could contribute to those efforts.

On a practical level, my time at SESYNC was also extremely valuable for me as an early-career researcher seeking to expand my professional network. On any given week, there were many opportunities to meet with a wide range of researchers from universities and organizations throughout the country (and sometimes, throughout the world). To my mind, this makes a post-doctoral fellowship at SESYNC unique from a traditional post-doc, where one would be linked primarily to a particular PI, Lab, and University.

On a methodological level, SESYNC pushed me to incorporate new tools and techniques. Specifically, my field (anthropology) is not a heavily quantitative field, nor is it often associated with "Big Data" and all the attendant software/methodologies (e.g. MySQL, R, coding). At SESYNC, I was encouraged to work with the cyberinfrastructure team to incorporate these skills into my work with data from the Alaska Department of Fish and Game.

Although these data were not "big" strictly speaking, they were part of a much larger data set maintained for the entire state of Alaska. My ability to integrate MySQL, R, and code into my analysis should facilitate greater integration with this larger data set down the road, and I am currently discussing plans with ADF&G to expand my analysis accordingly.

These skills have also come in handy with my participation in the Fisher/Ricketts SESYNC project on Conservation and Welfare. We are working with a global data set that synthesizes USAID DHS data with remote sensing data and the IUCN protected areas data set, with the goal of examining the linkages

between environmental condition, protected areas, and measures of well-being. I was encourage by both the PIs and SESYNC Leadership (Jon Kramer, Margaret Palmer, David Hawthorne) to join this group, but after the first meeting, I was honestly not sure how I could contribute. The group envisioned a largescale, global analysis, but my own research as an anthropologist had always been intentionally grounded in small-scale, local human-environment interactions. However, the first meeting did encourage me to start thinking at broader scales, and I began to formulate some methodological and theoretical approaches that could contribute to the goals of the working group. By the second meeting, I was able to draw on my background in anthropology and my initial training at SESYNC in working with large data sets to contribute a method for estimating wealth that would allow our group to compare measures between countries, rather than simply within countries, which is the default measure in the DHS data. It would have been hard for me to accomplish this without the training, assistance, and encouragement I received from SESYNC cyber-infrastructure staff (Mary Shelley, Mike Smorul, Ian Munoz, Travis Burrell, and Bill Shenk). In particular, Mary Shelley spent many hours with me so that I could begin to integrate MySQL and R, as well as helping me develop best practices for working with large data sets. I also want to mention that sharing an office with other SESYNC post-docs (Judy Che-Castaldo, Mary Collins) helped me tackle issues that I encountered in developing these skills. My fellow post-docs often helped me solve challenges in coding, or served as a great sounding board for trouble-shooting. Going forward, it is now much clearer to me how I can contribute to this SESYNC project, and I feel confident in my ability to do so, in large part because of the training I received during my post-doc.

On a theoretical level, my participation in the Fisher/Ricketts SESYNC project has also encouraged me to develop some ideas about human-environment interactions in the anthropocene that may help us better understand the reciprocal interactions between evolutionary and ecological change in human and non-human communities. Specifically, I am interested to investigate the linkages between environmental conditions linked to conservation and development, and human developmental, behavioral, and cultural responses. I worked with SESYNC postdoc Harish Padmanabha to formulate and agent-based model that applies aspects of this approach, and he and I also submitted a SESYNC workshop proposal to develop the idea further. Currently, I plan to test the utility of this approach, using the data set developed for the Fisher/Ricketts SESYNC group. I also plan to develop a manuscript that synthesizes research in ecology, evolution, and anthropology to present the approach.

All of this is my long-winded way of saying that my time at SESYNC gave me the intellectual freedom and stimulation to step outside my methodological and theoretical comfort zone, synthesize ideas across a wide-range of disciplines, and pursue exciting new projects with collaborators that I might never have come into contact with, had I not had the opportunity to be a SESYNC postdoc. I can't think of a better experience for early-career researchers, and I'm extremely energized and excited about making the most of these opportunities in my new position as an Assistant Professor at Oregon State University.

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

I was invited to give a presentation to the staff at the Wild Salmon Center in Portland, OR. WSC is active in salmon conservation throughout the North Pacific, including Kamchatka, Russia, where I have conducted research with small-scale, indigenous salmon fishers since 2005. My presentation provided on-the-ground perspectives from rural communities that are not often accessible to WSC employees. We discussed the challenges of balancing the economic and

ecological vulnerability of salmon with the social importance of salmon as part of indigenous people's traditional livelihoods, social relations, and cultural identities.

2. I participated in a workshop ("Mapping Ethnographic Landscapes in Kamchatka") co-sponsored by the University of Arizona and Google Earth Outreach. At the workshop, anthropologists working in Kamchatka met with Indigenous community leaders from Kamchatka to receive training in community-based, participatory mapping projects, using Google Earth technologies. In the future, the team plans to build on this training to lead additional workshops for communities in Kamchatka, with the goal of generating maps of traditional place names, land use, and locations with spiritual and/or historical significance.

#### Publicity in popular press:

1. Coverage of the Google Earth Outreach Mapping project: <u>http://uanews.org/story/ua-google-creating-digital-maps-to-help-preserve-cultural-heritage-of-russian-community</u>

#### Julio Postigo Publications:

#### Journal article:

 Postigo, J. C. (2014). Perception and Resilience of Andean Populations Facing Climate Change. *Journal of Ethnobiology*, 34(3), 383–400. Retrieved from http://www.bioone.org/doi/abs/10.2993/0278-0771-34.3.383#.VM-tQlpam00.mendeley

#### White paper/report:

2. Postigo, J.C., G. Blanco, and P. Chacón (2013). Social sciences at the crossroad: Latin America and the Caribbean facing global environmental change. World Social Science Report

#### Book chapter:

 Postigo, J. C., M. Montoya, and Young, K. R (2013). Natural resources in the subsoil and social conflicts on the surface: Perspectives on Peru's subsurface political ecology. Subterranean Struggles: New Dynamics of Mining, Oil, and Gas in Latin America University of Texas Press. Austin, TX.

#### Elise Larsen

#### **Presentations:**

1. Larsen, E.A. November 2014. "Estimating trends for North American butterflies using Citizen Science" Invited Seminar, Institute of Environmental Sciences, Jagiellonian University, Poland.

#### Data, software, tools, and websites produced from synthesis efforts:

- 1. I compiled a data library of butterfly mark-recapture field studies for use in a synthetic research and methods paper.
- 2. I am currently developing software tools for extracting butterflies from digital imagery, particularly for use with pinned specimens, and for analysis of the shape and color of these specimens. This work was initially supported by an EOL-BHL Research Sprint. In 2014 I began a collaboration with UK biologist and informaticist Yan Wong. In 2015 we will be pursuing additional funding for this work. This work will result in new data on butterfly color and shape.

#### Stories related to your synthesis efforts:

Preliminary results of synthesis of mark-recapture data show biased estimates of survivorship using existing tools to analyze transect surveys. My research will lead to best practices for analysis of these data which are common to butterfly monitoring.

#### Comments:

In 2014 I formed several new collaborations to further my research projects.

- 1. Related to wing morphology tool development I was funded to participate in an EOL-BHL Research Sprint at NESCent. I worked with Yan Wong (UK) in code development and began discussions with Will Pearse (McGill University).
- 2. Related to tools for estimating survivorship and lifespan in butterflies, I began a collaboration with two statisticians (Eleni Matechou and Emily Dennis, University of Kent, UK) and several field researchers throughout the U.S. and Europe to share data for a large scale methodological analysis.
- 3. Through my research at SESYNC I have worked with a wide range of scientists, not only in ecology and conservation, but also related to computation, wildlife management, public outreach, citizen science, and more.

## Mary Collins **Publications**:

#### doneations.

#### Conference proceedings:

- Collins, MB (2014). 'Toxic Outliers' and Sociology Theory: How Empirical Disproportionalities in Environmental Privilege Impact Modern Theory. 2014 Annual Meeting of the American Sociological Association, San Francisco, CA.
- 2. Collins, MB (forthcoming). Double Disproportionality: a Framework for Integrating Environmental Privileges and Problems. Social Science Quarterly.
- 3. Collins, MB (2013). Industrial Disproportionalities, Environmental Inequality, and the Powers of Legitimation. 2013 Annual Meeting of the American Sociological Association. New York, NY.
- Collins, M.B and Freudenburg, W.R. (2013) Temporal Myopia: A Case of Promising New Technologies, the Federal Government, and Inherent Conflicts of Interest. pp 259-276 In Susan Maret (ed) Research in Social Problems and Public Policy Vol 17. Emerald Group Publishing Limited, Bingley UK.

#### **Presentations:**

- 1. Collins, MB. (2014) Panelist "Integrating Environmental Privileges and Problems in the Assessment of Environmental Justice." Annual Meeting of the Association of Environmental Studies and Sciences (June, New York, NY)
- 2. Collins, MB. (2014) Cafe Scientifiqué: "Science for the Price of Coffee" Integrating Environmental Privileges & Problems to Devise Solutions Cafe 49 West, Annapolis, Maryland (October)
- Collins, MB. (2014) Invited Presenter "Integrating Environmental Privileges and Problems at Multiple Scales." Meeting of US Environmental Justice Consortium (February, USC, Los Angeles, CA)

- Collins, MB. (2013) Panelist/Presenter "Ethical Positions and Nanotechnology Acceptance: A Social Component of Environmental Sustainability." 2013 Annual Meeting of Sustainable Nanotechnology Organization (SNO) (November, Santa Barbara, CA) with SK Hanna, BH Harthorn
- 5. Collins, MB. (2013) Panel Organizer and Presenter "Public Perception of Nanotechnology Risks and Risk Managers." 2013 Annual Meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET) (October, Boston, MA) with Drs. SK Hanna, BH Harthorn
- Collins, MB. (2013) Panel Organizer and Presenter "Ecotypes, Risk Perception, and New Technologies." 2013 Annual Meeting of the Society for Social Studies of Science (4S) (October, San Diego, CA) with SK Hanna, BH Harthorn, and T Satterfield
- Collins, MB. (2013) Selected Presenter "Industrial Disproportionalities, Environmental Inequality, and the Powers of Legitimation." 2013 Annual Meeting of the American Sociological Association (ASA) (August, New York, NY)
- 8. Collins, MB. (2013) Panelist "Environmental Risk Judgment Analysis: Nanotechnology and Consumer Products." 2013 Annual Meeting of the Association for Environmental Studies and Sciences (AESS) (June, Pittsburgh, PA) with SK Hanna, BH Harthorn, and T Satterfield
- 9. Collins, MB. (2013) Invited Research Colloquium "Environmental Justice and the Central Coast" University of California, Santa Barbara, Bren School of Environmental Science and Management (University of California, Santa Barbara) (November)
- Collins, MB. (2013) Invited Seminar (University of Maryland) "Using Double Disproportionality as a Framework for Integrating Environmental Privileges and Problems" University of Maryland, The Program for Society and the Environment (University of Maryland) (October)

#### Grants submitted for follow-on funding:

- Pulver, S and Collins, MB (2015). Egregious Polluters: A socially-structured explanation of disproportionality in the production of pollution. Submitted to the National Science Foundation, Directorate for Social, Behavioral & Economic Sciences: Science of Organizations (Pending: Submitted 2/2/2015; amount of \$479,753)
- 2. Mohai, P, Ash M, and Collins MB (2015) Examining the causes and consequences of environmental inequality over time: A data-driven computational approach. National Socio-Environmental Synthesis Center, University of Maryland. (Funded working group)

#### Media/publicity:

 Grund, Nancy. 2014. Now You See It. Feature news story generated by the College of Computer and Mathematical, & Natural Sciences at the University of Maryland. Access at: <u>http://cmns.umd.edu/news-events/features/2217</u>

#### Student involvement/training:

1. 2015 Bayesian Statistics for Ecologists and Social Scientists (University of MD) National Socio-Environmental Synthesis Center (10-day Course Co-Taught with H. Thompson Hobbs)

#### Harish Padmanabha

#### Publications:

1. Working paper to be submitted to special issue of *Ecology and Society*:

Padmanabha H, Correa, F, Gerkey D, Downey S. The centripetal force of community: an analytical framework for studying the adaptation of human time allocation in changing socioecological conditions.

Major Revision reviewed and Minor Revision recommended (pending). *PLOS Neglected Tropical Diseases*: Socio-ecological drivers of fine-scale dengue transmission: a systems analysis and field evidence from Colombia. Harish Padmanabha, Fabio Correa, Camilo Rubio, Andres Baeza, Salua Osorio, Jairo Mendez, James Holland Jones and Maria A Diuk-Wasser.

#### **Presentations:**

1. Small-Scale Societies and Environmental Transformations: Co-Evolutionary Dynamics. Barcelona 17-18 December 2014.

#### Proposals/follow-on funding:

- 1. Co-PI NSF Pre-Proposal submitted January 2015 (#7547352): Linking temperature and behavior to ecological and evolutionary consequences in ectotherms.
- 2. Co-PI SENACYT submitted January 2015 (pre-proposal accepted, full proposal submitted): Effect of land use change on the reproductive rate of mosquito-borne viruses in Darien, Panama.

#### Neil Carter Publications:

#### Published:

- 1. Carter N.H., M. Jasny, B. Gurung, and J. Liu (2015). Impacts of people and tigers on leopard spatiotemporal activity patterns in a global biodiversity hotspot. Global Ecology and Conservation 3: 149–162. doi: 10.1016/j.gecco.2014.11.013
- Carter, N. H., A. Viña, V. Hull, W. J. McConnell, W. Axinn, D. Ghimire, and J. Liu. 2014. Coupled human and natural systems approach to wildlife research and conservation. Ecology and Society 19(3): 43. http://dx.doi.org/10.5751/ES-06881-190343
- Carter NH, B Gurung, A Vina, H Campa, JB Karki, J Liu (2013). Assessing spatiotemporal changes in tiger habitat across different land management regimes. Ecosphere 4(10):124. http://dx.doi.org/10.1890/ES13-00191.1

#### In revision:

 Carter, N.H., J.D.C. Linnell, M. Gore, A. Dickman, J. Baird Callicott, V. Athreya, N. Lescureux. 2015. The keys to coexistence: realizing the potential for integrating large predators into multiuse landscapes. Frontiers in Ecology and the Environment. In revision.

#### **Presentations:**

- 1. Carter, N.H. October 29, 2014. Understanding human-tiger conflict. World Wildlife Fund human-tiger conflict working group meeting in Chitwan, Nepal.
- Carter, N.H. June 15, 2014. The keys to coexistence: realizing the potential for integrating large carnivores into multi-use landscapes. North American Congress for Conservation Biology (Missoula, MT, USA).

 Carter, N.H. February 17, 2014. Synthesizing social and environmental data and theories to advance tiger conservation. Helmholtz Centre for Environmental Research – UFZ (Leipzig, Germany).

#### Popular press/media:

- 1. Smithsonian Magazine, <u>http://www.smithsonianmag.com/smart-news/conserving-tigers-could-hurt-leopards-180953585/?no-ist</u>
- 2. Nature World News, <u>http://www.natureworldnews.com/articles/11057/20141210/tiger-conservation-forces-leopards-into-human-territory.htm</u>
- Yale e360, <u>http://e360.yale.edu/feature/people\_or\_parks\_the\_human\_factor\_in\_protecting\_wildlife</u> /2707
- 4. Maryland International, <u>http://www.international.umd.edu/sparkplug/common/images/oip/MI-Fall2-2013.pdf</u>

#### **Collaborations:**

Through my postdoctoral work at SESYNC I have had the opportunity to form new scientific collaborations with individuals from numerous institutions around the world. New collaborators include Drs. John Linnell (Norwegian Institute for Nature Conservation), Volker Grimm (Helmholtz Centre for Environmental Research), Adrian Treves (University of Wisconsin-Madison), Meredith Gore (Michigan State University), Jens Frank (Swedish University of Agricultural Sciences), Guillaume Chapron (Swedish University of Agricultural Sciences), Simon Levin (Princeton University), Adam Barlow (WildTeam), Amy Dickman (Oxford University), J. Baird Callicott (University of North Texas), Vidya Athreya (Wildlife Conservation Society), Nicolas Lescureux (Norwegian Institute for Nature Conservation), Arlyne Johnson (Wildlife Conservation Society), Mahendra Shrestha (Smithsonian Conservation Biology Institute), José Vicente López Bao (Swedish University of Agricultural Sciences), Jeremy Bruskotter (The Ohio State University), and Richard Damania (The World Bank).

#### **Broader Impact of Work:**

In collaboration with the World Wildlife Fund, the agent-based model of tiger population dynamics I developed with my colleagues at Helmholtz Centre for Environmental Research, WildTeam, and Princeton University is being expanded to include additional field sites (India, Bangladesh, and Russia) across the tiger's range. Expanding the model to these sites will ensure generalizability of the model and provide useful insights for conservation planners at these sites and others like them.

#### Lorien Jasny Publications:

#### In press:

 Jasny, L and Lubell, M (2015). Two-Mode Brokerage in Policy Networks. Social Networks 41 (36– 47). <u>https://www.sesync.org/sites/default/files/webform/results/Jasny\_Lubell\_TwoModeBrokerage.pdf</u>

#### **Presentations:**

 Two Mode Brokerage in Policy Networks -- Sunbelt conference on Social Networks Mental Models in Adaptive Rangeland Management -- INGroup conference on networks in teams Networks of Contention -- Climate Change Protests in the European Union -- Political Networks Conference Networks in Urban Ecology -- American Political Science Association conference

#### Proposals submitted for follow-on research

- 1. UMD Advance seed grant with Prof Kanesha Bond under review -- "Multilevel Networks and the Takfir Movement in Lebanon, 1990-2014."
- 2. NSF Hazards SEES grant with Prof Jennifer Hernandez under review -- "Integrated Systems Approach for Flood Management in Urban Communities (ISYSTEM-FLO)"

#### Students involved with project and/or trained:

1. Jonathan Cox - phD student at UMD

#### Andres Baeza

#### **Presentations:**

1. Epidemic malaria and reactive control under land-use change and environmental variability March 2015

#### Data, software, tools, and websites produced from synthesis efforts:

- 1. A simple example of a socio-environmental system: coupled rabbit and farm dynamics
- 2. Cooperation in Unpredictable Environments: A Socio-ecological Model for the Dynamics of a Semi-desert Community

#### David Gill Also see: 2012T3-007

#### **Publications:**

1. Gill DA, Schuhmann PW, and Oxenford H (2015). Recreational diver preferences for reef fish attributes: Economic implications of future change. *Ecological Economics*.

#### **Presentations:**

 Gill, D., Oxenford, H., Schuhmann, P. Economic valuation of reefs to the reef fishing and scuba diving industries in the Caribbean. A Community on Ecosystem Services (ACES) 2014 Conference, Arlington, VA (Washington DC) USA, 9 December, 2014

#### Jampel Dell'Angelo Publications:

#### Accepted:

- 1. Dell'Angelo, J., Rulli, MC., D'Odorico, P., "The Tragedy of the Grabbed Commons". Full paper accepted at the World Bank Land and Poverty Conference 2015.
- 2. Baldwin, L., Washington-Ottombre, C., Dell'Angelo, J., Cole, D., Evans, T. "Polycentric Governance and Irrigation Reform in Kenya", accepted in Governance.

#### In revision and re-submitted:

3. Bixler, P., Dell'Angelo, J., Mfune, O., Roba, H. "The Political Ecology of Participation: A Cross-Continent Assessment", R&R in The Journal of Political Ecology

#### Submitted:

4. Dell'Angelo, J., McCord, P., Gower, D., Carpenter, S., Caylor, K., Evans, T. "Revisiting Institutional Design Principles for Community-Based Water Management", submitted to Mountain Research and Development.

#### Conference abstracts/proceedings:

- 5. Dell'Angelo, J., Rulli, MC., D'Odorico, P., "The Tragedy of the Grabbed Commons". World Bank Land and Poverty Conference 2015, March 23 -27.
- 6. Dell'Angelo, J., D'Odorico, P., "Grabbing the Commons". 15th Biannual Global Conference, International Association for the Study of the Commons, Edmonton Alberta, May 25-29, 2015.
- 7. Dell'Angelo, J., D'Odorico, P., Rulli, MC., The Global Water Grab Syndrome: which institutions matter? ISSRM 2015 Conference, Charleston, USA June 13-15, 2015

#### **Presentations:**

- Dell'Angelo, J. "Water, conflicts and power: is it all about institutional arrangements?" University of Freiburg, Department of Economic Policy and Constitutional Economic Theory, Freiburg, Germany. 13th January 2015.
- Dell'Angelo, J., Muriuki, C., Evans, T. "Who decides? Investigating dynamics of community water projects on Mount Kenya". International Food Policy Research Institute (IFPRI). Washington, DC, USA. 13th November 2014.

#### Student training/involvement:

1. Dell'Angelo, J., Workshop on Elinor Ostrom's Work and Analytical Frameworks. 10th December 2014, SESYNC, Annapolis, MD, USA.

#### Databases/tools developed:

I am creating a database on land-grabbing and large-scale land acquisitions by coding information about institutional arrangements, commons, coercion, mechanism of acquisition, land-use change, and actors. At this stage I have ~40 cases across 30 countries prevalently from peer-reviewed articles.

#### New collaborations:

I started a new collaboration with University of Freiburg's Land Research Group with the objective of creating an EU-USA partnership on Land and Water Grabbing to look for funding and develop common research projects and activities. At this stage potential members of the partnership are from the following Universities: SESYNC-University of Maryland, University of Freiburg, University of Virginia, Bern University, Autonomous University of Barcelona, Indiana University.

Kristina Hopkins Publications:

#### Published:

 Hopkins K.G., N.B. Morse, D.J. Bain, N.D. Bettez, N.B. Grimm, J.L. Morse, M.M. Palta, W.D. Shuster, A.R. Bratt, A.K. Suchy. Assessment of variation in stream flow responses to urbanization and the persistence of physiography. In press. Environmental Science and Technology.

#### Submitted:

2. Hopkins K.G., N.B. Morse, D.J. Bain, N.D. Bettez, N.B. Grimm, J.L. Morse, M.M. Palta. Type and timing of stream flow changes in urbanizing watersheds in the Eastern U.S. Submitted. Elementa Special Issue on Urban Streams.

#### In prep:

 Utz, R.M., K.G. Hopkins, L. Beesley, D. Booth, R.J. Hawley, M. Baker, M.C. Freeman, K.L. Jones. Do specific natural watershed and channel attributes confer ecological resistance to urbanization in streams? In prep to be submitted in Feb 2015. Freshwater Science Special Issue on Urban Streams.

#### Workshop Hosted:

1. GIS Intro: What data? What structure? What software?. Workshop Leaders: Kristina Hopkins, Lauren Yeager, and Ian Muñoz. Participants: SESYNC Post-docs. Date: 12/17/2014.

#### **Presentations:**

- K.G. Hopkins. From small watersheds to regions: Variation in hydrologic response to urbanization. Invited seminar at the Center for Urban Environmental Research and Education University of Maryland Baltimore County in Baltimore, MD, February 2015.
- K.G. Hopkins, N.B. Morse, D.J. Bain, N.D. Bettez, N.B. Grimm, J.L. Morse, M.M. Palta. Characterizing hydrologic alterations following urbanization using gradient and long-term approaches. Poster presentation at the 17th Annual Central Arizona Phoenix LTER All Scientists Meeting in Tempe, AZ, January, 2015.
- R. Rossi, E. Elliott, D. Bain, K. Crowley, M. Steiner, M. Divers, K. Hopkins, L. Giarratani, M. Gilmore, K. Povis, and L. Scherloum. ENERGY-NET (Energy, Environment and Society Learning Network): Best Practices to Enhance Informal Geoscience Learning. Poster presentation at the American Geophysical Union Annual Meeting in San Francisco, CA, December 2014.
- 4. S. Lavin, D. Bain, K. Hopkins, E Pfeil-McCullough, and E. Copeland. Estimating the limits of infiltration in the urban Appalachian Plateau. Poster presentation at the American Geophysical Union Annual Meeting in San Francisco, CA, December 2014.

#### Datasets developed:

- 1. Pittsburgh Green Infrastructure Inventory
  - Worked with collaborators at the Pittsburgh Water and Sewer Authority and Three Rivers Wet Weather to compile a database of green infrastructure projects in Pittsburgh, PA. The database currently includes 250 green infrastructure projects in the Pittsburgh area and includes a detailed project description and project location. This database will be used to update the Pittsburgh Regional Green Infrastructure Map in March of this year.
- 2. U.S. Green Infrastructure Plan Database

Constructed a database of U.S. cities that have created Green Infrastructure Plans to address the requirements outlined in combined sewer overflow (CSO) NPDES permit requirements. The database currently includes the top twenty CSO cities and includes a description of plan goals, combined sewer system characteristics, plan costs (gray vs green infrastructure), and timelines.

#### Lauren Yeager Publications:

#### In press:

1. Fodrie, FJ, Yeager, LA, Layman, CA, Grabowski, JH, and Kenworthy, MD. In press. Intrapopulation variation in habitat use driven by landscape connectivity and seasonal patch availability. Oecologia.

#### In review:

2. Peters, JR, Yeager, LA, and Layman, CA. In review. Comparison of fish assemblages in restored and natural mangrove habitats along urban shorelines of Biscayne Bay, Florida. Bulletin of Marine Science.

#### In prep:

- 3. Yeager, LA, Valdivia, A, and Cox, CE. In prep. Occupancy-abundance relationships in Caribbean reef fish assemblages and the effects of marine reserves. To be submit to Diversity and Distributions.
- 4. Yeager, LA, Keller, DA, Burns, TR, Pool, A, and Fodrie, FJ. In prep. Habitat fragmentation per se affects community diversity at landscape scales. To be submit to Ecology Letters.
- 5. Deith, MCM, McPherson, JM, Yeager, LA, and Baum, JK. In prep. Environmental controls on functional diversity of near-pristine coral reef fish communities. To be submit to Global Ecology and Biogeography.

#### **Presentations:**

1. "Applications of GIS to Landscape Ecology" as part of "GIS Day": an introduction/overview of various uses of GIS in socio-environmental research for SESYNC post-docs

#### Data in development:

- 1. Environmental data for Pacific/global coral reefs: I am currently extracting and processing the following environmental data for >3,500 coral reef survey locations across the Pacific Ocean:
  - Bathymetric slope
  - Net primary productivity (water column)
  - Sea Surface Temperature (SST)
  - Human population densities
  - Connectivity with other reef habitat

Once my methods for creating "ecological-tuned" variables (e.g., annual minima or variation in SST) are finalized, I will work on creating a global data layers for selected variables for all mapped coral reefs sites based on a Reefs at Risk Revisited reef locations.

# Matthew LaFevor **Publications:**

#### In press:

 LaFevor, M.C., Environmental concerns facing the U.S. and Mexico: an international perspective. In Neighborly Adversaries: Readings in U.S.-Latin American Relations, 3<sup>rd</sup> Edition. Michael J. LaRosa and Frank O. Mora, eds. (Roman and Littlefield).

#### Submitted:

- Suding, K., Higgs, E., Palmer, M., Callicott, J. B., Anderson, C. B., Baker, M., Gutrich J. J., Hondula, K. L., LaFevor, M. C. Larson, B. M., Ruhl, J. B., Schwartz, K. Z. Seeing the forest and the trees: comprehensive ecological restoration. *Science*.
- 3. Ramos-Scharrón, C. C. and LaFevor, M. C. *Relevance of Hortonian overland flow to localized and watershed-scale runoff response in a tropical dry forest environment: the role of unpaved roads.*

#### In prep:

- 4. LaFevor, M. C. and Ponette-González, A. G. Large-scale water harvesting in Mexican national parks.
- 5. LaFevor, M. C., Schwartz, K. Z., Anderson, C. B. The role of ecosystem services in political ecology: synthesis and assessment.
- 6. LaFevor, M. C. and Burnside, B. The human-environment macroecology of colonial Mexico.
- 7. LaFevor, M. C. and Butzer, E. K. Snow harvesting in colonial Mexico: environment and society.
- 8. LaFevor, M. C. Environmental and economic impacts of explosives production in colonial Mexico.

#### **Presentations:**

 2014. Restauración de las Laderas Montañosas de Tepetate con Tecnología Tradicional: Problemas y Posibilidades. Abstracts, Ecología, Manejo y Conservación de los Ecosistemas de Montaña en México: Hacia la Articulación de la Ecología y la Dimensión Humana. Universidad Veracruzana (INBIOTECA) (INECOL), Xalapa, México. (presentation)

#### Proposals submitted for follow-on research:

1. LaFevor, D. C. and LaFevor, M. C. (\$12000) submitted. Creating a digital archive of ecclesiastical documents from Santiago de Cuba and Baracoa, Cuba. Seed grant proposal submitted to the Endangered Archives Programme. London, UK.

#### Stories related to your synthesis efforts:

During my first several months at SESYNC I began several collaborative efforts. I am working with Bill Burnside on a paper; with Nick Magliocca on a mapping project; with Baird Callicott's Ecological Restoration/Ecosystem Services group (several papers in submitted/in prep); and a collaborative effort with the other postdocs to be revealed at a future date. My collaboration with Alexandra Ponette-González is developing as well, and we have a couple of papers in the works. The SESYNC setting has so far proved to be as beneficial to my work as I had hoped.

#### Outreach [specifically for knowledge users, e.g. NGO, non-profit, govt, business]:

As a SESYNC postdoc I gave a lecture to a course (Conservación de Suelos - Soil Conservation) at the University of Veracruz - Acayucan, Mexico, via Skype. This opportunity came about after I presented at the conference listed above and made some contacts there.

#### Publicity in popular press:

My interview with Melissa Andreychek about my experiences with Baird Callicott's group was published online on the SESYNC website.

#### Comments:

I do not have many ideas for improvement so far. I suppose I wish we had a bigger, better document scanner, but this is minor. It is difficult to imagine a postdoc opportunity that could have provided me a better environment for professional development. I have time to do research, collaborate, and write, and this is exactly what I need.

## SESYNC LEADERSHIP/STAFF/SCIENTISTS

#### Margaret Palmer

Products listed below only are those that resulted from SESYNC-related work, working groups, students, or collaborators.

#### **Publications:**

- Palmer, M.A. 2012. Socio-environmental sustainability and actionable science. *Bioscience* 62: 5-6.
- 2. Palmer, M.A. and C. A. Febria. 2012. The heartbeat of ecosystems. Science 336:1393-1394
- Pahl-Wostl, C., A. Arthington, J. Bogardi, S. Bunn, H. Hoff, L. Lebel, E. Nikitina, M.A. Palmer, L. Poff, K. Richards, M. Schluter, R. Schulze, A. St-Hilaire, R.E. Tharme, K. Tockner, and D. Tsegai. 2013. Environmental flows and water governance: managing sustainable water uses. *Current Opinion in Environmental Sustainability* 5:341-351.
- 4. Pahl-Wostl, C., M.A. Palmer, and K. Richards. 2013. Enhancing water security for the benefits of humans and nature the role of governance. *Current Opinion in Environmental Sustainability* 5: 676-684.
- 5. Palmer, M.A., S. Filoso, and R.A. Fanelli. 2014. From ecosystems to ecosystem services restoration as ecological engineering. *Ecological Engineering* 65: 62-70
- Acuna, V., T. Datry, J. Marshall, D. Barcelo, C.M. Dahm, A. Ginebreda, G. McGregor, S. Sabater, K. Tockner, and M.A. Palmer. 2014. Temporary streams and rivers – new policy instruments. *Science* 343: 1080-1081.
- Palmer, M.A., B. Koch, and K. Hondula. 2014. Ecological restoration of streams and rivers: shifting strategies and shifting goals. *Annual Review of Ecology, Evolution, and Systematics* 45: 247-269.
- 8. Palmer, M.A. and K. Hondula. 2014. Restoration as mitigation: analysis of stream mitigation for coal mining impacts in southern Appalachia. *Environmental Science and Technology* 48: 10552-10560.

- Moglen, G.E. and M. A. Palmer. 2014. Physics attributed to curve number model illustrate need for caution, and ecological responses often lag restoration efforts. *Proc. Natl. Acad. Sci.* 111(23): E2356. doi:10.1073/pnas.1400119111
- 10. Hosen, J., O.J. McDonough, C. Febria, and M. A. Palmer. 2014. Dissolved Organic Matter Quality and Bioavailability Changes across an Urbanization Gradient in headwater streams. *Environmental Science and Technology* 48: 7817-7824.

#### Presentations directly related to SESYNC work or collaborators including SESYNC GRAs

- 1. 2011 M.A. Palmer. Invited. Socio-environmental synthesis and the Bioeconomy. National Science Foundation.
- 2. 2012 M.A. Palmer. Invited. Socio-cultural context as a driver of the science of ecological restoration. 41st Oosting Lecture, Duke University.
- 3. 2012 M.A. Palmer. Invited. Managing and restored freshwater ecosystem services: formal and informal institutional constraints. "Developing Ecologically-Based Conservation Targets under Global Change" The 2nd Emerging Issues Conference of the Ecological Society of America.
- 4. 2012 M.A. Palmer Invited. The present and future of translational ecology. Ecological Society of America annual meetings, Portland, Oregon.
- 5. 2012 M.A. Palmer. Research priorities for the National Socio-environmental Synthesis Center. Ecological Society of America annual meetings, Portland, Oregon
- 6. 2012 Palmer, M.A., Invited. Restoring ecosystems to restoring ecosystems services: a paradigm shift? EcoSummit 2012.
- 2013 Palmer, M.A. Invited keynote. Building Community and Improving Leadership of Cyberinfrastructure Enterprise: the SESYNC example. Conference held at University of Michigan
- 8. 2013 Palmer, M.A. invited keynote. The "Is" and the "Ought" in Ecological Restoration. University of Wisconsin Ecology Symposium, Day 1. Madison, WI.
- 9. 2013 Palmer, M.A., Invited plenary. Socio-cultural contexts that shape reciprocal interactions between natural resource exploitation and scientific responses. Society for Freshwater Sciences. Jacksonville, FL.
- 10. 2013 Palmer, M.A. Invited Moore lecture. University of Virginia. Watershed Restoration through a Socio-Ecological Lens.
- 11. 2013 Palmer, M.A. Invited. Restoration and socio-cultural dynamics. Columbia University.
- 12. 2014 Hondula, K. and M.A. Palmer. Restoration as mitigation: ecological vs. regulatory approaches to evaluating stream restoration outcome. Joint Aquatic Sciences Meeting, Portland OR.
- 13. 2014 Palmer, M.A. Invited. Climate change and aquatic natural capital as buffers. Environmental Defense Fund, New York
- 14. 2014 Palmer, M.A. Invited Keynote. Future of Natural Resources Conference, North Carolina State University, N.C.
- 2015 Acuna, V., Ruhi-Vidal, A., M. A. Palmer. Temporary streams: current management challenges and promising solutions. International Congress of Conservation Biology, Montpelier, FR.

#### Datasets or tools developed:

1. Raw data used in meta-analysis of all publications reporting on the outcome of stream and river restoration globally. Format: R.

2. Raw data and data summaries of the outcomes from stream mitigation projects in the Appalachian mining regions. Data obtained through FOIAs. Format: R.

#### Engagement and/or exchange with knowledge users:

- 1. Environmental Protection Agency, Office of Water in D.C. and Chesapeake Bay Program in MD
- 2. Restoration Practitioners extensive network
- 3. Panel with several federal policy makers on Ecosystem Services
- 4. Meetings with Environmental Banking representatives
- 5. Conference with Water Managers from across the U.S. (at Aspen Institute)

## Bill Fagan

#### Publications:

- 1. Kavathekar, Devtulya and Mueller, Thomas and Fagan, William F. (2013). Introducing AMV (Animal Movement Visualizer), a visualization tool for animal movement data from satellite collars and radiotelemetry. Ecological Informatics. 15: 91-95.
- 2. Mueller, T and Dressler, G and Tucker, C and Pinzon, J and Leimgruber, P and Dubayah, R and Hurtt, G and Bohnig-Gaese, K and Fagan, William F. (2014). Direct anthropogenic effects on long-term global trends in photosynthetic capacity. Remote Sensing.

#### Presentations:

 Will Weston-Dawkes: An Agent Based Modeling Approach to Predicting the Effect Anthropogenic Pressures on the Movement Patterns of Mongolian Gazelles. Swarmfest 2014. Notre Dame University (Swarmfest is an annual conference for researchers in CS and related fields who are using sophisticated agent based modeling)

#### Students involved:

These 8 undergrads formed my Gemstone team on animal movement, which was supported as an official SESYNC activity. You may not have all of their names and only Matt Rice was physically at SESYNC (this past summer). You can see the diversity of majors / backgrounds represented (e.g., 4 diff colleges).

- Gibb, Connor Matthew ENGR COMP ENGIN SR
- Kleyman, Michael Alexsandr CMNS BIO SCI: CEBG SR
- Koelbel, Maria Christine CMNS MATHEMATICS SR
- Natoli, Rebecca Joan AGNR ENV S&P-WILD SR
- Orlando, Kyle Richard ENGR COMP ENGIN SR
- Rice, Matthew David ENGR MAT SCI&ENGR SR
- Weber, Claire Yvonne BSOS GEO SCI GIS SR
- Weston-Dawkes, William Pet ENGR ENGR-MECH SR

#### Data/software/tools:

The AMV (Animal Movement Visualizer) Software package itself, which is available at <u>http://www.clfs.umd.edu/biology/faganlab/movement/</u>.

## Safa Motesharrei

#### Project Titles:

- 1. Human And Nature Dynamical Model (HANDY): A novel model to do "thought experiments" on societal dynamics, specifically population and resource-use.
- 2. Coupled Human-Climate-Water Model (COWA): A model to investigate water availability and consumption at the watershed level considering impacts of climate change. Model is used to study various water management options and policies.
- 3. Identifying local climate impacts of forests.
- 4. Causality Analysis for Time-series signals with Convergent Cross Mapping (CCM) Method.

#### **Publications:**

#### Peer-reviewed articles:

- BozorgMagham, Amir E., Safa Motesharrei, Stephen G. Penny, and Eugenia Kalnay. 2015. "Causality analysis: identifying the leading element in a coupled dynamical system." 2015. PLOS ONE. (Accepted)
- Li, Yan, Maosheng Zhao, Safa Motesharrei, Qiaozhen Mu, Eugenia Kalnay, and Shuangcheng Li. 2015. "Local cooling and warming effects of forests based on satellite observations." Nature Communications. (In print)
- Motesharrei, Safa, Jorge Rivas, and Eugenia Kalnay. 2014. "Human and Nature Dynamics (HANDY): Modeling Inequality and Use of Resources in the Collapse or Sustainability of Societies." Ecological Economics 101 (May): 90–102. doi:10.1016/j.ecolecon.2014.02.014.
- 4. Castro, Rodrigo, Peter Fritzson, François Cellier, Safa Motesharrei, and Jorge Rivas. 2014. "Human-Nature Interaction in World Modeling with Modelica." In Proceedings of the 10th International Modelica Conference, 477–88. Lund, Sweden. doi:10.3384/ECP14096477.

#### **Presentations:**

- 1. Sustainability Indicators for Coupled Human-Earth Systems, Smithsonian Environmental Research Center (SERC) Distinguished Seminar Series (Invited), Annapolis, MD, Feb 2015
- 2. Exploring Water Management Options with COWA: A Coupled Human-Climate-Water Model, 95th Annual Meeting of the American Meteorological Society (Invited), Phoenix, AZ, Jan 2015
- 3. Population and Carrying Capacity: Metrics for Sustainability, NIST-ASCE-ASME Joint Workshop on Measurement Science (Invitation Only), Reston, VA, June 2014
- 4. Minimal Models of Human-Nature Interaction, Computer Systems Colloquium (Invited), Stanford University, Stanford, CA, May 2014
- 5. HANDY: Human And Nature Dynamics, Applied Dynamics Seminar (Invited), Institute for Research in Electronics and Applied Physics (IREAP), UMD, May 2013
- 6. Exploring Water Management Options with COWA, Oral Presentation, Graduate Research Interaction Day, UMD, April 2014 (Won the First Prize)
- 7. Exploring Water Management Options with COWA, Oral Presentation, American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, December 2013
- 8. A Minimal Model for Human and Nature Interaction, Invited Seminar, National Socio-Environmental Synthesis Center (SESYNC), Annapolis, MD, October 2013

#### **Proposals:**

- University of Maryland Council on the Environment Seed Grant: "Studying the future of the Chesapeake Bay Watershed Region by Coupling Socio-Economic and Earth-System Models". PI: Prof. Klaus Hubacek. Jan 2014. \$90K.
- 2. Community Infrastructure for Transformation of urban ecosYstems through anticipatory and adaptive Energy-populatioN interactions (CITY-EN), Investigator, with Prof. Jelena Srebric as the Principal Investigator. Feb 2015. \$12M.

#### Tools/databases developed:

1. HANDY and COWA computer simulation models

#### **Publicity:**

1. HANDY paper publication news in thousands of media, including The Guardian, IFLScience, and NPR.

#### Student involvement/training:

1. Modeling Coupled Human-Natural Systems, GEOG 738E, Fall 2014, UMD (Co-taught with Prof. Klaus Hubacek)

#### Other:

- 1. [Hosted speaker] Prof. Malcolm Potts, Former Bixby Chair in Population and Family Planning, UC Berkeley School of Public Health, UMD School of Public Health Grand Rounds Lecture: "Crisis in the Sahel: Climate Change and Overpopulation". Sep 2014.
- 2. [Hosted speaker] Sir Robert Watson, Strategic Director, Tyndall Center, University of East Angelica, UMD Council on the Environment Distinguished Lecture, "Planet Under Pressure: The Imperative to Act". Oct 2014.
- 3. American Meteorological Society Summer Policy Colloquium, Graduated in June 2014, Won \$5K award from NSF that covered the full tuition.

#### Cindy Wei Publications:

## Published:

1. Cynthia A. Wei, William R. Burnside, and Judy P. Che-Castaldo (2014). Teaching socioenvironmental synthesis with the case studies approach. Journal of Environmental Studies and Sciences. DOI 10.1007/s13412-014-0204-x

#### Accepted:

2. Fry, Catherine and Wei, Cynthia. Sustainability Matters for Undergraduate Teaching and Learning. Journal on Excellence in College Teaching.

#### Tools/databases developed:

 32 case studies are available on the SESYNC website that were developed as part of or as a result of the short course "Teaching Socio-Environmental Synthesis with Case Studies" which will be offered for the 4th time in July 2015. Case studies contain all information and material required for an instructor to use the case for teaching: teaching notes, learning goals/objectives, guidance on classroom management of the exercise, suggested assessment questions, and supplementary material such as videos/Powerpoint presentation.

2. 5 Tutorials about socio-environmental synthesis and socio-environmental science: each tutorial is a written text introducing some basic concepts important to underestanding socioenvironmental systems and synthesis

#### Student training/participation:

- 1. Postdocs Judy Che-Castaldo and Bill Burnside helped create two of the case studies, co-authored the paper about teaching with case studies with me, and helped develop and run the short course.
- Postdocs Andres Baeza-Castro and Neil Carter also participated in the 2014 case study short course, and co-developed a modeling exercise for use in the short course and with our summer interns.

#### Engagement and/or exchange with knowledge users:

1. Café Scientifique presentation on September 25, 2014.

## SESYNC RESEARCH FELLOWS

## Nick Magliocca

#### **Publications:**

- Magliocca, N.R., Brown, D.G., McConnell, V.D., Nassauer, J.I., Westbrook, S.E. (2014). Effects of alternative developer decision-making models on the production of ecological subdivision designs: Experimental results from an agent-based model. Environment & Planning B: Planning and Design, 41(5), 907-927. DOI:10.1068/b130118p.
- Magliocca NR, Brown DG, Ellis EC (2014). Cross-Site Comparison of Land-Use Decision-Making and Its Consequences across Land Systems with a Generalized Agent-Based Model. *PLOS One*. 9(1): 1-14. DOI: 10.1371/journal.pone.008617
- 3. Magliocca, NR et al (2014). Synthesis in land change science: methodological patterns, challenges, and guidelines. *Regional Environmental Change*. DOI: 10.1007/s10113-014-0626-8
- Schmill, M.D., Oates, T., Gordon, L.M., Magliocca, N.R., Ellis, E.C. (2014). GLOBE: Analytics for assessing global representativeness. Geo'14: Proc. 5th Int. Conf. on Computing in Geospatial Research and Applications, Washington, D.C.

#### **Presentations:**

- 1. "Data-Driven Synthesis for Investigating Food Systems Resilience to Climate Change". Presented at AGU Fall Meeting 2014, December 19, San Francisco, CA, USA.
- 2. "Investigating the effects of repeated storms and 'near misses' on adaptation responses to coastal hazards". Presented at AAG Annual Meeting 2014, April 8, 2014, Tampa, FL, USA.

#### Submitted grant proposals:

1. "Demographic and Environmental Resilience in the American Plains", National Institute of Child Health and Development, \$187,863.

 "CyberSEES Type 2: Collaborative Research: Scaling Agent-Based Models of Complex Land-Use Dynamics and Transitions for Regional and Global Scale Modeling". National Science Foundation, \$606,131.

#### Datasets or tools developed:

- 1. Food and Water Systems Resilience to Climate Change datasets for Data to Motivate Synthesis Program
- 2. Navigable data ontology for Data to Motivate Synthesis Program

#### Engagement and/or exchange with knowledge users:

- 1. Established collaboration with Vince Breneman, Economic Research Service, USDA
- 2. Established collaboration with Emily Read, USGS