Abstracts - Wednesday, June 13, 2018

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Keynote Plenary

Ray Hilborn
University of Washington

A comparison of the environmental costs of food

Production of all foods has environmental costs but there has been no systematic comparison of the costs across the range of food production systems. We conducted a review of 148 assessments of animal source foods (ASF) production for livestock, aquaculture and capture fisheries that measured four metrics of environmental impact (energy use, greenhouse gas emissions, release of nutrients and release of acidifying compounds into ecosystems) and standardized these per protein production. We also reviewed additional literature on freshwater demand, pesticide use and antibiotic use. There are up to 100 fold differences in impacts between specific products and in some cases for the same product; the lowest impact production technologies were capture fisheries for small pelagics and aquaculture for molluscs. The highest impact methods were industrial beef production and catfish aquaculture. Regulatory restrictions on ASF production methods, as well as consumer guidance, should consider their relative environmental impact, and currently there appears to be little relationship between regulatory restrictions and impact in most developed countries. We also discuss the biodiversity cost of different production systems.

Contributed Talks by Theme - Session D

under Stress: Healing the Enlightenment Rift: Clashing Worldviews in Times of Stress

Aaron Wolf
Oregon State University

Deep social and institutional stresses in 17th and 18th centuries Europe contributed to what we refer to as "the enlightenment," a dramatic shift in worldviews which likewise influenced striking changes in our approach to relationships with the environment and with each other. Two central realignments resulted, with reverberations that still exist today. First, the worlds of rationality and of spirituality were considered distinct and separate, and public discourse and the legitimacy of evidence newly favored the former. Second, and related, the supremacy of humanity was likewise elevated above what heretofore had been its "servant" role in relation to nature and the divine. This panel seeks to investigate the potential of re-integrating rational and spiritual understandings of socio-environmental stresses, in the context of currently prevailing economic, ecological, and strategic constructs. We begin by assessing current social and political divides over an increasingly stressed environment, then by documenting the geography

of what has been referred to as the "Enlightenment Rift" – the process by which the global North separated out the worlds of rationality from spirituality at a very specific place and time – and the impact of this rift on ideas related to natural resources management. We continue with an examination of the current clash of worldviews, as the North entwines its rational construct with the flow of international development capital and management philosophies, and the inevitable disconnect as these approaches collide with the more-integrated views of the global South and East. We investigate how worldviews clash both within the US and internationally, yet also how they might gently be interwoven, healing the rifts between individuals, groups, and nations, and between people and their environment.

Max Eriksson
Swedish University of Agricultural Sciences

The return of the wolf to Sweden, a media analysis

On the 1st of January 1966 the grey wolf (Canis lupus) was listed as a protected species in Sweden. This conservation based policy ended a bounty-based system that been in place for 318 years, and allowed the wolf to return to Sweden. Five decades later the Swedish wolf has gone from being functionally extinct to a population consisting of 355 animals (2017), making the decision to protect the wolf an ecological success story.

However, return of wolves to Sweden has also had an impact on social and political systems, which pose a challenge to future wolf conservation. Attitudes towards wolves in Sweden have become more negative processes which likely have been driven by indirect factors, such as social identity and rural political alienation, and media attention.

I will be presenting highly novel findings from a quantitative content analysis of all Swedish printed media from 1986 to 2017 that mention wolves (approx. 80000 texts). These results will be combined with data on the Swedish wolf population, wolf policy, and public opinion on wolves, in order to examine how the media discourse drives, or is being driven, by other social and ecological factors.

Sammy Matsaw
University of Idaho

An Indigenous Scientist's Perspective: A First Foods Ecology Concept

There is a culture of life around the world attracted to rivers and streams. Indigenous peoples of Turtle Island (North America) tell stories about the roles of plants and animals for their survivance upon highly modified landscapes from colonialism. There is a loss of cultural and ecological diversity laden with hubris assumptions and contradictions justifying the protection and continuation of the status quo: the human-nature divide found through "the Enlightenment". There are two issues with the major assumption above about Indigenous contributions of new knowledge, through bringing forth old knowledge, this presentation will outline, a difference in concepts and overall perception of reality evidenced by: first, language use and linguistics, and; secondly, culturally-based epistemological orientations. Both of these ideas taken together expands the scientific enterprise for Indigenous peoples to (re)-claim and expand new areas of our thought and knowledge to the betterment of the environment for plants, animals, and human- beings. Primarily, kinship begins our perspective of how we shape the world. Our science would provide alter-(Natives) to how humans are seen as separate from the environment, rather they are actors in the forces of change. From traditional ecological knowledge (TEK) tribes have been asking salmoncentric managers to consider lamprey and freshwater mussels, and in the Columbia River Treaty renegotiation; ecosystem processes. Because bifurcating ourselves from nature is not part of our cultural orientation then it follows in an Indigenous Science framework we would continue to see ourselves along those rivers, on the land and part of the ecosystem.

Wondwosen Michago Seide
Lund University

When Emotion Meets the River: The Hydro-Emotional Politics over the Nile

We all have emotions. Emotions dictate everyday politics (Hutchison and Bleiker, 2014). Starting from the Enlightenment period, rationality dominated world politics. There was a belief that reason was good and emotion was bad. This was mainly due to the work of classical political philosophers such as Aristotle, Plato, and Descartes' famous dictum 'I think, therefore I am', which epitomized the superiority of reason over emotion (McDermott, 2014:557). Contrary to this view, nowadays, scholars such as Jonathan Mercer and Neta Crawford (2014), pioneers in the field, have perceptively placed emotion 'at the very heart of political reasoning' They have successfully refuted the dichotomy of emotion and rationality. According to them "emotions and cognition are intrinsically interwoven" (Ibid.:503). I argue that emotions permeate hydro-politics. Emotions such as fear, anxiety, anger, regrets and trust have always been punctuating the Nile hydropolitical relations. This paper's *raison d'être* is, therefore, to question the traditional hydropolitics analysis that has always been concerned with power, geopolitics, cooperation and conflict perspectives. Moreover, I strongly probe the unquestioned and unexamined fixation on the *rationality-centered* analysis of the Transboundary Rivers.' The governance of Nile waters has not been governed by reason and rationality, but also impacted by emotions of the policy makers, the engineers, the water users and the public at large. Unless we unearthed the emotional aspect of the Nile River and its people, we will fail to get the whole grasp of the transboundary water analysis. By drawing on the hydro-political psychology emotion, I am trying to show, how emotion can play a role and influence the present hydropolitical relations in the Eastern Nile.

Christiana Zenner
Fordham University

Western modernities' colonial, industrial, extractive, economic and scientific proclivities have given rise to specific forms of development as well as inequality and environmental degradation worldwide. Since the 1967 publication of Lynn White Jr.'s now-(in)famous essay in Science magazine, at least part of the blame has been laid on the shoulders of Christianity, which White viewed as "the most anthropocentric religion the world has ever seen." This presentation depicts how one prominent global religious institution—the Catholic Church—seems in the past several decades to be expanding its discourses on liberal development and environmental degradation, on the one hand by advancing anthropocentric notions of rights-to- the-environment (as in its advocacy for the right to water at the U.N.), and on the other hand by moving toward more inclusive formulations of environmental integrity and human ethical obligation, as in Pope Francis's encyclical Laudato Si'. Particularly relevant notions drawn from these discourses include: recognition of intersecting environmental and social degradations linked to extractive capitalist economies; articulation of ethical principles including the preferential option for the poor, the common good, and obligations to future generations; and a nascent commitment to the epistemic and moral authority of indigenous communities. After charting those key ideas from within Catholic social teaching, this presentation articulates strong external critiques that are gleaned in conversation with critical theories of the Anthropocene and decolonial scholarship, in order to propose several lessons and future directions for remediating ongoing theological and institutional residues of the "Enlightenment Rift."

Margreet Zwarteveen
IHE-Delft and University of Amsterdam

Rivers as relations: re-thinking Environmental Flows

Environmental Flows (EF) is one of a range of initiatives to speak in more green or environmentally conscious ways about rivers, with the explicit purpose of managing these more sustainably (avoiding degradation or promoting conservation). EF thus directly engages with the wider question of environmental representation, in the two senses of the word: on the one hand, representation as the operative term within political (or management, governance) processes that seek to extend visibility and legitimacy to the river as a societal and public concern, creating political support for institutional or technological interventions to help conserve or protect it. On the other hand, representation as the normative function of a language, which is reveals or distorts what is assumed to be true about rivers. Hugely oversimplifying (and following Latour 2004), one way in which the Enlightenment Rift manifests itself is that modern societies—at least ideal-typically— have delegated the two forms of representation to specific societal realms: political representation happens (or is supposed to happen) in the realm of political decision making,

while representation in terms of revealing what is real belongs to (or is supposed to belong to) the realm of science or academia. The assumption of a fundamental divide between nature and society mirrors as well as feeds this separation.

The Environmental Flows initiative (or should I say movement) remains more or less faithful to this modernism in how it presents, promotes and discusses the knowledge it produces. Indeed, using 'the natural' as the foundation for its truth claims is what (is supposed to) lend(s) credibility and authority as well as convincing power to the proposals of the EF community. Ironically, therefore, the political strength of EF arguments importantly rests on how they are presented as expressly scientific and therefore non-political. Inspired by the ideas of Donna Haraway, as well as by those of Jessica Weir, an Australian river anthropologist, I use this presentation to discuss and explore the possibility of anchoring EF attempts in less modernist conceptions of nature and society (or politics). My conclusion is that EF can serve as a beautiful and inspiring example of doing ecological politics in less modern ways, ways that are pragmatic, tentative, humble and experimental.

in Transition: Ecosystems in transition: change, adaptation, and social-ecological resilience

Changing local and global socioeconomic conditions have contributed to changes in the pattern and intensity of land and resource use in forest-dependent communities across the globe. Commercial exploitation of timber and nontimber forest products, shifts in land cover from diversified to simplified agroecological systems, and habitat degradation due to changes in fire regimes, spread of invasive species and other factors, have all increased worldwide. This session focuses on these human-dominated forests and other terrestrial ecosystems, as social-environmental systems in transition. The talks will address change and adaptation in human-environmental interactions in these systems and some of their social and ecological outcomes, with the ultimate goal of discussing and identifying strategies that can maintain biodiversity, and the ecological processes that sustain it, while building social resilience.

Tamara Ticktin
University of Hawaii Manoa

A potential win-win: biodiversity conservation and community resilience in Fijian agroforests

The need to design and promote agricultural systems that are compatible with the conservation of biological diversity is widely recognized. Many studies have focused on the ecological factors that promote native biodiversity conservation in agroecosystems, but the social variables that influence native biodiversity in these systems remain poorly understood. This gap is critical to address, since agroecosystems are social-ecological systems, where social systems pertaining particularly to governance and knowledge both shape, and are shaped by, ecological structure and dynamics. We demonstrate an approach to identify social-ecological linkages that affect biodiversity outcomes in agroecosystems and in social-ecological systems more broadly. We focused on coastal agroforests in Fiji, which, like agroforests across other small Pacific Islands, are critical to food security and contain much of the country's remaining lowland forests. However, over the past few decades, levels of native biodiversity in these systems have declined rapidly with shifts towards monocultures of crops and non-native timber trees, and increasing habitat degradation due to invasive species. We tested the relationships among social variables and native tree species richness in agroforests with structural equation models. The models were built with data from ecological and social surveys in 100 agroforests and associated households. The agroforests hosted 95 native tree species of which almost one-third were endemic. The best-fit structural equation model ($R^2 = 47.8\%$) showed that social variables important for community resilience — local ecological knowledge, social network connectivity, and livelihood diversity — had direct and indirect positive effects on native tree species richness. Cash-crop intensification, a driver of biodiversity loss elsewhere, did not negatively affect native tree richness within parcels. LEK was also positively correlated with total plant richness and negatively correlated with cover of invasive species. Joining efforts to build community resilience, specifically by increasing LEK, social network connectivity, and livelihood diversity, can be a key strategy for conservation agencies to help conserve the rapidly declining biodiversity in the region.

Georgia Fredeluces
University of Hawaii Manoa

**Biocultural conservation of a culturally-significant wild harvested herb, Xerophyllum tenax
(Melanthiaceae) in the Pacific Northwest, U.S.A.**

In the Pacific Northwest, Native Americans have utilized fire and other management approaches over millennia to care for and maintain ecosystems that support community needs. In the subalpine, fire has been used as part of a management system that maintains canopy openings and supports the quantity and quality of desirable species. This type of traditional knowledge and practice is valuable today, in the context of fire suppression, logging, climate change, colonialism and species loss, but the best practices to restore these biocultural connections are not always clear. In order to support ecological restoration and cultural revitalization of Native American practices involving plants, and in order to learn more about the challenges faced in my home state, I designed this dissertation project to gather and synthesize ecological, ethnographic and educational data surrounding the demography, use and management of beargrass (Xerophyllum tenax Melanthiaceae). Beargrass is an understory forest herb harvested culturally for use in basket making, and which is cultural cornerstone in the Pacific Northwest. It's abundance and quality are threatened by fire suppression, commercial harvest for the floral industry, and other factors. Here we ask 1.) How do fire suppression, harvest and climate influence plant population growth and leaf qualities needed for weaving?, and 2.) What are the recommendations and experiences of tribal weavers and tribal youth for the restoration of beargrass plants and basket traditions? We surveyed 2000 plants across burn severities annually 2015-2017 in north central Oregon. Field data were used to parameterize regression models that were used to build Integral Projection Models to explore the influence of fire regimes and abiotic factors on beargrass long-term persistence and leaf quality. To gather perspectives and recommendations, I attended basket weaving events and gatherings, learned to weave, interviewed expert tribal weavers, and also co-designed and implemented educational programming for Native youth, including surveying youth on their perspectives and knowledge of basket making and other cultural traditions. With respect to plant demography, we found that the long-term persistence of beargrass populations was highest under low severity fire. Tribal recommendations included restricting commercial harvest and increasing access. Tribal youth indicated a high level of interest in their cultural traditions, including basketry, with sometimes limited opportunity to learn this information. Taken together, this suggests that beargrass has a high potential for biocultural revitalization with application of low-severity fire, the support of public agencies in improving access, limitations on commercial harvest, and greater support for cultural programming for tribal youth on and off reservation.

Michelle Portman
Technion -- Israel Institute of Technology

Coastal cliff collapse is a problem faced along many shorelines the world over, especially as cliffs tend to be impacted by global climate change. Problems of cliff collapse can benefit from interdisciplinary policy responses that synthesize principles of three paradigms: integrated watershed management, integrated coastal zone management and water sensitive urban design. This exploratory, largely empirical research, looks at how local and national policies address coastal cliff collapse along Israel's Mediterranean seashore, in a way that highlights impediments and opportunities for integrated planning. Findings emphasize the importance of addressing urban runoff to prevent coastal cliff collapse using practices originating based on the three paradigms. Conclusions provide insights about policies that could improve the resilience of coastal communities suffering from coastal cliff collapse in the era of climate change. Particularly, greater cross-scale (regional and national) efforts are needed to coordinate proper drainage of the watershed which along coastal cliffs involves integrating principles of watershed management, coastal management and urban design practices. These should be aimed at implementing practices that reduce phenomena that lead to cliff destabilization, such as insuring runoff diversion and building setbacks. The case study research leads to recommendations for policy mechanisms that provide opportunities to implement such practices.

Steven Scyphers
Northeastern University

Urbanization and shoreline armoring erodes complexity in coastal social-ecological systems

Coastal shorelines represent complex and dynamic social-ecological systems (SES). Although natural habitats along this land-sea interface typically support high levels of biodiversity and ecosystem services, shoreline armoring and land transformation driven by societal desires other urbanization processes degrade ecosystems and highlight complex trade-offs impeding sustainable coastal development. To assess the impacts of armoring and urbanization on societal perceptions and preferences for shorelines, we report survey panel data representing 2,200 residents across 8 coastal states in the northeast U.S. We used fuzzy-logic cognitive mapping to elicit "mental models" of shoreline SES dynamics involving nine key concepts: natural habitats, seawalls, beaches, marine life, recreation, fisheries, water quality, water access, and storm protection. Our results revealed that shoreline armoring and urbanization were associated with less diverse mental models (i.e., fewer key conce pts, connections) representing simplified and more homogenous perceptions of shorelines. Coupled with known residential-scale drivers of shoreline armoring, such as prioritized yet misperceived cost-effectiveness of natural and artificial shoreline structures, our results indicate a potential societal-level erosion of ecological knowledge associated with urbanization. Considering that shared knowledge shapes culture, and out of culture comes attitudes, preferences, and behaviors, recognizing and reversing this erosion of knowledge diversity is essential for successfully managing complex systems and promoting adaptive capacity along coastlines.

Keir Strickland
La Trope University

Emilio Rodríguez-Izquierdo
National Autonomous University of Mexico

A Boundary Object Approach for Identifying Critical Ecological Thresholds: The Case of Whale Watching in Ojo de Liebre, Mexico.

The development of a boundary object (BO) —an artifact that facilitates communication among stakeholders— provides a means for generating the necessary knowledge about a system's critical ecological threshold taking into consideration different stakeholders' views on highly uncertain futures.

The case of whale watching in lagoon Ojo de Liebre, Mexico, exemplifies the challenges of crafting governmental regulations under conditions of deep uncertainty —that is, within a context of such complexity that there is no agreement on the appropriate modeling method to inform policy-making. One way to address deep uncertainty is through computational modeling that permits an exploration of multiple scenarios to capture different stakeholders' views. Thus, we illustrate the development of a BO approach to identify a critical ecological threshold that allows determining the maximum number of whale watching boats, or carrying capacity, in Ojo de Liebre.

Carrying capacity was conceptualized as the critical ecological threshold indicating a potential transition to a low resilience state of the gray whale (Eschrichtius robustus) breeding population in the lagoon. Operationally, our BO approach combined system dynamics modeling, to simulate the boats' impact on the breeding habitat, with ecological risk assessment, to determine the probability of crossing a critical ecological threshold. We found that this approach responds in a practical and systematic way to the demands of developing more robust management strategies under conditions of deep uncertainty.

by Design: Designing Environmental Justice

How can we bring socio-environmental systems research and design practice together to build healthier, more environmentally just communities? How can we both critically examine and materially support fundamental elements of eco-social systems, such as food, water, air, and waste? And how can we combine those concerns in support of communities who have yet to see the benefits of five decades of environmental legislation and regulation? The papers in this session engage these core questions from a wide range of disciplines, addressing topics including land use change, culturally reflexive stewardship, resilience to coastal flooding, and air quality impacts from fracking.

Rebecca Lave
Indiana University

Justice in Socio-Environmental Systems Research

In this talk, I introduce the session "Designing Environmental Justice" by examining the concept of justice and how more explicit attention to it might complement and deepen our SES research. The word "justice" is relatively rare in the SES literature. According to Web of Science, of the ten most cited papers only Adger 2005 explicitly addresses questions of justice. Of the nearly 4,000 papers that list socio-ecological systems as their topic, only a fraction include justice anywhere in the text or bibliography. While this includes thoughtful treatments such as Lebel et al. 2006 and Cote and Nightingale 2011, in many cases "justice" is not a focus of analysis but a tangential mention (e.g. Walker et al. 2004 note that robustness, vulnerability, and risk are categories as imprecise as justice). I argue here that engaging more deeply with justice could reshape our research in both academically and politically productive ways, changing the questions we ask, the data we gather and analyze, and the ways we disseminate our work.

Javier Arce-Nazario
University of North Carolina Chapel Hill

Using remote sensing as art to spur community discussion of land use change over time

Public involvement in environmental decision-making is integral to environmental justice, and conversations between communities and researchers are often crucial elements of landscape change research in human-dominated landscapes. In this talk I will argue that presentations of geovisualizations, which are well-recognized as venues for "scientific outreach," are also an appropriate method to measure and enhance community awareness of issues related to land-use change. Based on an exhibit of a half-century of landscape change in Puerto Rico, I will describe a process of creating "slow visualizations" that foster useful interactions between and among researchers and community members, helping both groups to collaboratively envision desirable environmental outcomes

Dean Hardy
SESYNC

Legacy vulnerability: A historical environmental justice perspective on flood risk

Vulnerability is often defined as the potential for harm and risk as the probability of exposure to a hazard. In this framing, risk assessments are useful, but not sufficient for investigating vulnerability of socio-environmental systems. This is because both the "potential of vulnerability" and the "probability of risk" are co-produced via the entangled social and environmental relations that precipitate harm, relations that are always in flux. To mitigate vulnerability equitably with just implications requires addressing what in 2017 Grove and colleagues referred to as "the legacy effect." Such a historical perspective on environmental justice compels scholars to assess the historical socio-political conditions that shaped – and continue to shape – the potential for harm of underrepresented communities to flood risk. In this paper, I examine how the history of racialized property relations in the United States has shaped flood risk in coastal communities by drawing from historical analyses of African American struggles for land and theory on race and racial inequality. I show how power inequalities across racial difference created opportunities for wealthy white landowners to manipulate and coerce African American residents in coastal communities. In many instances, such power imbalances led to households and entire communities being relocated, which affected the flood risk of many families. Through a case study of Sapelo Island, Georgia, I argue that designing environmental justice demands being attuned to how the racialized history of socio-environmental change has shaped the present-day potential for harm from flooding for many African American households.

Andrea Sarzynski
University of Delaware

Promoting Resilience and Reducing Vulnerability through Urban Climate Governance

Cities worldwide are actively engaged in a wide variety of efforts to improve their resilience and capacity to respond to impending climate hazards such as sea level rise and extreme heat. Improving governance may be an important ancillary strategy to overcome barriers to collective action on climate adaptation due to fragmented authority and resources. Nevertheless, we have little understanding of the effects of governance efforts on climate resilience of critical systems and infrastructure, and social vulnerability. This paper uses a case survey methodology to evaluate recent efforts to strengthen the capabilities of actors in and out of government to collectively respond to climate hazards. Special attention will be paid to efforts that empower citizens to chart their own future, such as through participatory planning. Implications will be drawn from the cases for the design and operation of governance arrangements in other cities engaging in urban climate adaptation.

Robert Winthrop
University of Maryland, College Park

Building Theory from Practices: Design Principles Underlying Culturally Reflexive Stewardship

Stewardship represents one set of solutions for effective environmental management, emphasizing a distinctive configuration of knowledge, motivation, and social embeddedness, in contrast to market-based and regulatory approaches. More specifically, 'culturally reflexive stewardship' (crs) describes a class of human / natural system linkages, interweaving landscape, community, and culture. It involves collective actions to sustain a way of life, motivated by a shared appreciation of place, and expressed through practices that transmit local knowledge and affirm a social identity. While crs often provides the logic and motivation for advocacy or protest, supporting environmental justice goals for indigenous, minority, or voiceless communities, it may be characteristic of most distinctive social groups with multigenerational ties to specific environments. Examples could include American Indian tribes in Oregon, Amish farmers in Pennsylvania, or cattle ranchers in South Dakota.

This presentation first identifies design principles underlying crs, which include (1) the social construction of environmental experience, (2) the symbolic character of environmental knowledge, and (3) the multidimensionality of environmental value, reflecting cultural frames for experiencing, preserving, and appropriating the attributes of place and landscape. crs involves intrinsically motivated behavior, contrasting with the extrinsic incentives that characterize most environmental policy. The presentation then considers whether such design principles offer opportunities for improving policy responses to global environmental challenges, such as energy and resource conservation.

Sara Wylie
Northeastern University

Second Science: Grounding Extractions' Hazards through Counter-Mapping Collaboratives

Can we develop a "second" form of science in which academic-community collaborations use open source, low-cost citizen science tools to "ground," or record the industry's physical impacts on peoples and places? This "grounding" makes apparent the environmental health consequences of extractive industries and questions how these industries are technically enabled by a corporate, academic approach to science that excludes communities and externalizes the costs of extraction. We examine our interdisciplinary research team's efforts to develop a community-centered method for mapping and measuring hydrogen sulfide (H_2S), a neurotoxic gas associated with oil and gas production. This project builds on science and technology studies (STS) to challenge and transform how scientific knowledge about the environmental and human health impacts of extractive industries is generated and who can generate it. Methodologically we detect H_2S and other corrosive gases with photographic paper, as its layer of silver gelatin darkens when it reacts with sulfur. The tarnished photopaper is then mapped to visualize a community's exposure across a given landscape. Our team of community organizers, concerned residents, exposure scientists, and STS researchers is working to develop and validate this method through testing in Texas and Canada. This paper reflects on the research team's struggle to both critique dominant scientific approaches to exposure assessment and validate the assay to produce data that are useful for communities attempting to enact changes in regulations or provide evidence in court cases.

Plenary Lunch & Boundary Spanning Reflections Panel

Socio-Environmental Systems under Stress

Torben Rick
Smithsonian Institute

We live on a planet under considerable environmental and social stress and face a mounting set of persistent and complex changes. From climate change to environmental catastrophes and disasters, infectious diseases, food security, and socioeconomic, power, and gender dynamics, human social lives are deeply intertwined with environmental issues. Reflecting on the panels, lightning talks, posters, and discussions, I synthesize research advances on socio-environmental systems under stress and highlight gaps in research and potential areas for future engagement. A transdisciplinary approach to evaluating socio-environmental systems under stress that integrates perspectives from the natural sciences with social, cultural, and historical perspectives has much to offer academic discourse, and our ability to transcend societal and environmental stressors more generally.

Socio-Environmental Systems in Transition

Kendra McSweeney
Ohio State University

Socioecological systems world-wide are changing—at paces that range from staggering to slow. As the rich array of research featured here makes clear, those changes are catalyzed by shifts in governance, new trade configurations, climate change, and much more. Those changes also raise a series of questions on which I will elaborate and reflect on through the lens of the research presented here as well as my own research. Among those questions: Just how do we define a socioecological system 'in transition'? If change is inevitable, presumably then so is transition. The challenge, then, appears to be to use our collective insights to figure out what forms of transition should be encouraged and which slowed. Further, to what extent are our notions of transitions bound up with particular ideas about scarcity? Often, transition in socio-ecological systems is defined in terms of looming scarcity—of water, land, or food—rather than in terms of the misallocation of abundant resources. A final question addresses the normative nature of transition: what forms of change are best, for humans and non-humans? A good way to explore this question is through the emergent work that envisions and tests desirable futures.

Socio-Environmental Systems by Design

Vernon Morris
Howard University

Responding to environmental change, whether instigated by natural or by human factors, in a sustainable and equitable way could be humankind's most persistent grand challenge. Developing an understanding the complexities of socio-environmental systems that enables prediction necessitates the incorporation of novel model applications, new approaches to data analysis, and different types of trans-disciplinary conversations. These conversations that are challenging and require a commitment to pushing beyond the limitations of our disciplinary comfort zones. They may require new questions regarding "old" topics and often a unique merging of qualitative and quantitative approaches.

I will provide a summary of my reflections on the panels, lightning talks posters and discussions associated with the challenges of working across multiple disciplines, across geospatial boundaries, and across spatio-temporal scales that inhibit truly integrative approaches to pressing socio-environmental problems. My aim will be to highlight some of the innovative perspectives from the workshop that span the many disciplines represented at this

workshop. I will combine these observations with insights from my work within a research center that has been formed to catalyze these specific types of collaborations.

Lightning Talks - Session C

Socio-Environmental Systems under Stress

Courtney Cecale
University of California, Los Angeles

On a cold, dry morning in the Peruvian Andes last year, dozens of angry campesinos marched to the top of a nearby peak and smashed the metal equipment that resided there. They knew the equipment was the property of the mining company that arrived in the 1990s and destroyed the water systems of their neighbors. And now they were certain the machine was delaying the seasonal rains by months, causing their crops to desiccate. Unfortunately, the equipment was a glacial lake flood outburst warning system, donated by scientists to help protect residents from the increased threat of overfull meltwater lakes above. Now, the lives of tens of thousands of people below are again at risk. This is hardly the first clash between climate scientists and residents, as equipment, exclosures, and research sites have been vandalized throughout the Cordillera Blanca for decades. But missing from this not so uncommon tale is the rightful fear, protective agency, and desire for sovereignty that factor into these acts. Based on 16 months of ethnographic research as an environmental anthropologist, this paper reveals the historical, cultural, and ontological conditions that underly scientific mistrust in the region. As researchers, both Peruvian and international, conduct studies with greater frequency in the region, my paper offers considerations for engaging ethically, respectfully, and with historical consideration in sites that have suffered forms of environmental trauma.

Shermin de Silva
Trunks & Leaves Inc. / UC San Diego

The small-reservoir irrigation system of Sri Lanka forms the heart of an ancient social-ecological system in a society where agriculture is central to culture, psychology and value systems. Reservoirs simultaneously facilitate human subsistence and enrich biodiversity particularly in dry monsoon-dependent landscapes. A striking example is the exceptionally high density of endangered Asian elephants that range in the resulting patchwork of cultivated and uncultivated lands, signifying positive synergy between human activities and wildlife. However, changes in land-tenure, demographics, and development priorities have altered land-use and aggravated human-elephant conflict, with accompanying shifts in mindset toward a p reference for clear separation between "human" areas and "wildlife" areas that run counter to ecological functionality. Climate change-induced variation in rainfall further stress this system. We want to understand how people and elephants share this landscape, and how it can be re-engineered to safely support both people and biodiversity. The core of this effort is a long-term individual-based study of more than 1000 elephants which circulate through Udawalawe National Park, a protected area. Paired with this, we have conducted comprehensive surveys of livelihoods, agricultural practices and conflict involving over two hundred respondents from surrounding villages and deployed camera traps to observe human and elephant activity outside protected areas. For the first time this will provide a more complete understanding of both the elephant and human sides of the story, to serve as the basis for interventions designed to test agricultural strategies that will facilitate continued coexistence. We seek cross-disciplinary collaborators for these mesocosm experiments.

Jampel Dell'Angelo
VU University Amsterdam

The neglected costs of water peace

Referring to the analytical definition of water wars, several scholars have coherently argued against the 'water leads to war thesis'. There are three main arguments that have contributed to successfully dispel the myths of water wars: i. inter-state cooperation prevails over conflict; ii. virtual water trade provides the opportunity to circumvent local water scarcity; iii. development of new technologies increases freshwater availability. These arguments converge

demonstrating that rather than water wars in the future, water peace will prevail. While we agree with these arguments, we find that hydropolitical theories have generally neglected the fact that the **conditions for inter-state water peace come with high socio-environmental costs**. In particular, the central idea that virtual water trade resolve issues of local water scarcity and therefore reduces tensions and escalation of violence among different countries does not fully take into account the fact that dynamics of transnational water appropriation have serious socio-environmental impacts on countries exporting virtual water. To conceptualize this phenomenon, we introduce the notion of 'hidden socio-environmental costs of virtual water transfer', which is understood as a specific form of environmental cost-shifting. The empirical support to our reasoning comes from the study of transnational large-scale land acquisitions and associated water appropriations, which represent an expanding phenomenon central in the contemporary global agrarian transformation.

Courtney Hammond Wagner
University of Vermont

Do household capitals mediate agricultural adaptation to hydro-climatic change? A SESYNC graduate pursuit study with evidence from the Indo-Gangetic Plains (India)

Millions of farm-based livelihoods in the Indo-Gangetic Plains (IGP) will be adversely affected by hydro-climatic change. Thus, agricultural adaptations are essential for protecting and improving rural well-being. Household "capitals" (e.g., natural, human, physical, and social) are commonly cited as indicators of livelihood adaptability and innovation. This paper empirically evaluates the validity of capitals as capacity-based indicators through a series of structural equation models. These models assess the extent to which household capitals mediate the relationship between over 1,000 farm households and their agricultural management adaptations in the states of Haryana and Bihar. We construct a single household capitals variable by aggregating 84 measurements of households' physical/infrastructural capital, owned or accessed assets, livelihood diversity, ability to reach market or commercialize, access to weather information, and social capital. We find that household capitals are a critical mediator in adopting agricultural adaptation strategies across both states. In particular, women-headed households and lower castes often engage in fewer agricultural adaptations, an outcome mediated by their lower "capitals" indicator. Based on our analysis, programs that improve women's access to finance, social networks, and their participation in formal agricultural institutions are likely to increase adaptation action. Similarly, improvements in the provisioning of agricultural infrastructure help expand adaptation strategies available for lower castes.

Steven Lade
Stockholm Resilience Center

Resilience offers escape from trapped thinking on poverty alleviation

The poverty trap concept strongly influences current research and policy on poverty alleviation. Financial or technological inputs intended to "push" the rural poor out of a poverty trap have had many successes but have also failed unexpectedly with serious ecological and social consequences that can reinforce poverty. Resilience thinking can help to (i) understand how these failures emerge from the complex relationships between humans and the ecosystems on which they depend and (ii) navigate diverse poverty alleviation strategies, such as transformative change, that may instead be required. First, we review commonly observed or assumed social-ecological relationships in rural development contexts, focusing on economic, biophysical, and cultural aspects of poverty. Second, we develop a classification of poverty alleviation strategies using insights from resilience research on social-ecological change. Last, we use these advances to develop stylized, multidimensional poverty trap models. The models show that (i) interventions that ignore nature and culture can reinforce poverty (particularly in agrobiodiverse landscapes), (ii) transformative change can instead open new pathways for poverty alleviation, and (iii) asset inputs may be effective in other contexts (for example, where resource degradation and poverty are tightly interlinked). Our model-based approach and insights offer a systematic way to review the consequences of the causal mechanisms that characterize poverty traps in different agricultural contexts and identify appropriate strategies for rural development challenges.

Abigail Sullivan
Arizona State University

A social-ecological systems approach to analyzing prohibited natural resource collection in protected areas

Protected areas (PAs) are critical for achieving conservation, economic, and development goals, but the factors that lead households to engage in prohibited resource collection in PAs are not well understood. We examine collection behaviors in community forests and the protected Chitwan National Park, in Chitwan, Nepal. Our approach incorporates unique household and ecological data, including structured interviews, spatially explicit data of collection behaviors measured with computer tablets, and a systematic field survey of invasive species. We pair our data with a framework that considers factors related to the household's demand for resources, barriers to prohibited resource collection, barriers to legal resource collection, and alternatives to resource collection. A statistical analysis identifies key drivers of prohibited collection, including perceptions of an invasive plant (the mile-a-minute weed, Mikania micrantha) within and around Chitwan National Park and socio demographic variables. The social-ecological systems approach reveals that household perceptions of presence of Mikania micrantha are more influential in resource collection decisions than the actual, ecologically-measured, presence of the plant. We explore the policy implications of our findings (e.g. designing equitable resource collection policies) and propose that employing a social-ecological systems approach leads to conservation-policy and scientific insights not possible with solely social or ecological approaches.

Angela Steward
Instituto Amazônico de Agriculturas Familiares

Of Floods and Fires: Examining the impacts of extreme weather events on occupation and livelihood patterns on the Amazon Floodplain

Amazonian floodplains are dynamic environments, where floods are central to ecological processes—provisioning fertile soils, natural resources and biodiversity. They are also sites of age-old human occupation home to diverse social groups subjected to a history of social, political and economic interventions. Over the past decade, extreme floods, droughts and fires have become increasingly common in Central Amazonian floodplains —causing stress to these socio-environmental systems. Using ethnography and spatial analyses (GIS), we examine the impact of extreme weather events on smallholders' (ribeirinhos) occupation and livelihood patterns in the middle Solimões region, Brazil. Research shows that these events have led to losses in large tracts of agroforests, planting materials and other household investments. Data also reveal a quick process of adaptation, where smallholders are moving their fields to higher grounds on the outskirts of regional cities. Many also now reside in urban areas—while still using floodplains for natural resource management. Access to land and housing in peri-urban areas is mediated by kinship and affinity networks, and thus is not universal. Families who lack this social capital continue to reside and farm in flood-prone areas. Given the historical importance of floodplains to social reproduction in Amazonia, insights into changes in resource access and occupation patterns are crucial to understanding the future of these dynamic SESs. On a broader level, our study contributes to international discussions on local responses to extreme weather events and adaptation to climate change.

Socio-Environmental Systems in Transition

Ashleigh Arton
Marine Stewardship Council

Can we move beyond anecdotal evidence and isolated case studies to assess voluntary sustainability standards? Achieving sustainable fishing, with growing global protein demand, and under increasing climate-related and other anthropogenic stressors, is not easy. Responsible sourcing from far-reaching seafood supply chains with inadequate traceability and monitoring is even harder. Voluntary Sustainability Standards (VSS), such as the Marine Stewardship Council (MSC), leverage market-based incentives for harvesters to adopt sustainable practices, and supply chain actors to selectively source their products. Although ecolabels are mostly based upon environmental criteria, they produce, by design, social and economic effects. These may include economic premiums, or changes in

supply chain power dynamics, and often have wider societal impacts, be it increasing transparency to consumers or exacerbating market barriers for small-scale fishing communities.

It's important to understand the mechanisms through which VSS deliver their intended change, as well as identifying any egregious unintended effects. However, current understanding of such mechanisms relies on little data or isolated case-studies. The MSC, with 13% of global wild-capture fisheries' harvest certified, works with a global network of stakeholders in the harvest and post-harvest sectors.

Here we present early results of large-scale interviews on socio-economic impacts of seafood ecolabeling in three pilot fisheries. These suggest mixed perceptions of the role of MSC, for example in empowering harvesters with respect to middle-man market price control, or in working with institutions, and open up new research questions. We discuss broad implications for how to design effective and responsible market-driven sustainability interventions.

Katie Epstein
Montana State University

Grasslands cove r nearly half the earth's surface and support vast assemblages of wildlife, diverse cultural heritages, and ecosystem services. In North America historically, extensive livestock ranching operations conserved intact grassland habitat to the benefit of local biodiversity. However, private grasslands across the American West are undergoing rapid social and ecological transition. One of the most influential drivers of change is new ranch ownership and management regimes, characterized by shifting land-use values and property management strategies that increasingly incorporate amenity-oriented uses (e.g., recreation, tourism, etc.) alongside or instead of production-based practices (e.g., livestock operations). Such changes in land ownership patterns and their implications for the ecology and human communities of the world's vanishing grasslands are a fundamental geographic question, yet contemporary knowledge of these dynamics in North America is limited. In this lightning ta lk, I will summarize the critical social-ecological dynamics, relationships, and feedbacks in grassland systems in an iconic North American grassland region, the Greater Yellowstone Ecosystem. Alongside this system description, I will present a novel research framework, the Property-Landscape Life Course (PLLC), which seeks to characterize land transitions by emphasizing the interactional social-ecological dynamics of property ownership regimes. My goal is to use this framework to facilitate the generation of new knowledge on the multi-directional feedbacks linking amenity-oriented property management approaches with social and environmental change in one of North America's most threatened biomes and provide a common platform for research on land ownership transition in settler societies the world over.

Laura Landau
US Forest Service

The global rise of disasters and extreme weather events is testing the ability of cities to handle stress. Increasingly, we see examples of the resulting long-term damage on places and people, from debt, to displacement, to trauma. Maintaining resilience in the face of these events requires more than good policy and physical infrastructure; it is the social ties between people that can make the difference between a temporary challenge and a life-threatening situation, particularly for already vulnerable residents. Yet while social cohesion enables some form of spontaneous aid--donations, volunteer networks, or recovery plans--it cannot create long-term stability.

How can government strengthen emergent response, providing structure without working against the existing social networks that play such a crucial role in disaster response and readiness? One approach to coupling grassroots response with the resources of a city can be seen in Seattle OEM's Community Emergency Hubs. In this model, residents identify physical locations, often communal spaces such as churches and community gardens, to be used as meet-up spots following disaster. While the city does not have specific protocol for these hubs to follow, they offer training resources and best practices, create a public map of hubs, and facilitate a large network of volunteer emergency responders. Looking at the strengths and challenges of the Seattle model, this lightning talk will outline some recommendations for other cities and communities facing stress, and begin to work towards identifying a role for new modes of governance in the context of social-ecological resilience planning.

Kristin Olofsson
University of Colorado Denver

Set in the policy arena of unconventional oil and gas extraction using hydraulic fracturing in Colorado, this research endeavors to explain how individuals make decisions regarding their involvement in highly contentious environmental policy issues. An essential part of the policy process is the maneuvering of political behavior to impact policy. Current theory in political behavior may be able to predict when an individual might participate and perhaps even why that individual chooses to participate, but extant theory does not tell us how an individual made that political behavior decision. We cannot understand the impact of political behavior within the policy process without constructing how individuals make decisions. To better understand how individuals make political behavior decisions, this research asks: What are the factors that influence political behavior decisions? Drawing upon a set of in-depth interviews of policy actors to identify the drivers of political behavior, this research is based on the Advocacy Coalition Framework (ACF) and supplemented with theories of institutionalism and behavioral economics to gain inferential leverage through qualitative explanation using process-tracing methodology. As resource availability becomes ever more limited, human-environment interactions are of considerable importance in the transition of socio-environmental systems. By focusing on the influences of political behavior decisions, this research generates knowledge about the diversity of political behavior that might be used in different socio-environmental contexts and contributes to our understanding of political outcomes.

Kristin Timm
George Mason University

The predominant model of how science interfaces with society often falls short of meeting the needs of organizations trying to respond to the socio-environmental challenges presented by climate change, especially in rapidly changing Alaska. In order to address these institutional and procedural barriers, many scholars and practitioners alike have called for the adoption of more synergistic research activities developed through close collaboration and communication. However, this approach often pushes the boundaries of both decision makers' and research scientists' formal education. In order to design future knowledge systems that can overcome these challenges and facilitate opportunities in socio-environmental systems management, a better understanding of how participants learn to bridge science and decision making and how they transfer these skills is needed. Guided by theories from knowledge management, training, and organizational communication, these questions will be studied using a content analysis and in-depth interviews. Using web pages, agendas, needs assessments, and other documentation from existing capacity building activities from across the US, the content analysis will provide a synthesis of existing capacity building activities, including the format, participation, and informational content. In depth interviews with 10 training program managers will be used to better understand how these largely tacit skills are developed, codified, and transferred to others in formal training programs and activities for ongoing support. The findings will be used by the Alaska Center for Climate Assessment and Policy (ACCAP) and other Alaska boundary organizations to develop, implement, and evaluate future capacity building programs and activities.

Jonathan Thompson
Harvard University

The northeastern U.S. leads the country in the number of invasive insects, which are having significant impacts on ecosystems by selectively removing tree species and altering forest processes. The region is a predominantly forested and eighty percent of the forest area is managed by hundreds of thousands of uncoordinated private woodland owners. In addition to their direct impacts, invasive insects also have a strong influence land-use decision-making, often prompting salvage or preemptive harvesting, which can have distinct and compounding impacts on ecosystems. We used focus groups and surveys to understand how private landowner decision-making and intention to sell their land are influenced by imminent or on-going insect infestations. We then created a landowner typology that captures the social and environmental variation in land-use behavior based on characteristics of the forest owner and their forests. We applied the typology at the parcel level and used it to dictate patterns of management within a system of coupled spatial models designed to simulate land-use as it interacts with insect spread and forest dynamics. Our survey results suggested that few land owners are induced to sell their land in response to the presence of forest insects. However, there is considerable variation in landowners' harvest response to invasive insects, and it is related to the parcel size, owner income, educational attainment, and the timber value of the host tree. Our simulation results confirm the hypothesis that the land-use response to invasive forest insects can have

greater ecological consequences than forest insects themselves.

Jacob Weger
University of Georgia

The Mekong Delta of Vietnam has been recognized as a global hotspot of vulnerability to the effects of climate change, sea-level rise in particular. Compounded by upstream dam developments and local exploitation of land and water resources, in the coastal zone this is manifested by increasing saltwater intrusion and unstable weather patterns, challenging the agricultural livelihoods so important to this region. This has spurred domestic and international efforts to direct a transition to a more sustainable and climate-resilient development pathway. Based on the principles of adaptive governance, successful climate change adaptation requires knowledge exchange across governance levels and social networks to enable coo rdinated responses to change. Yet knowledge is never just transferred directly but is translated from context to context, reinterpreted by different actors to suit particular experiences and interests, and the trajectory in which adaptation plays out still depends largely on the livelihood decisions of local farmers. In this lightning talk I present the framework and preliminary results of my dissertation research on the politics of translation involved in the governance of climate change adaptation in the Mekong Delta. Based on multi-scalar ethnographic fieldwork at sites in Vietnam, the Netherlands, and a coastal province of the Mekong Delta facing an expanding brackish environment, this presentation explores the governance linkages through which knowledge is transmitted, and considers its articulation with local conditions, policies, and practices to produce socio-environmental transformation in the delta.

Socio-Environmental Systems by Design

Mollie Chapman
University of Zürich

Using Relational Values to Design Steward-Centered Payments for Ecosystem Services Programs

How can we design payment for ecosystem services (PES) programs that are ecologically effective, cost-efficient and popular? PES programs often implicitly assume economic motivations, where increasing enrollment requires paying more or demanding less. But empirical evidence points to the prevalence of non-economic motivations, which present both risks and opportunities to traditional PES designs. The PES literature and my empirical studies on programs in Washington State, British Columbia, and Costa Rica show how local actors are shaping PES programs to align with the non-monetary motivations and values of participants. I conducted over 80 interviews with land stewards, program managers, intermediary organizations, and local and regional experts about environmental values and PES design. Beginning with relational values, as developed by Chan et al. (PNAS, 2016, 113 (6), pp 1462-1465), I propose focusing on three key relationships: steward—land, steward—community, and ste ward—program. For each relationship, I discuss key relational values and how these can be reinforced—or alternatively undermined—by program design. For example, a design based on the steward—community relationship targets specific stream reaches to achieve both ecological connectivity and social reinforcement of stewardship among neighbors. By focusing on land stewards' valued relationships, program design can use payments to facilitate and validate, rather than incentivize, stewardship actions. I propose that designing 'steward-centered' programs can improve PES programs' effectiveness, efficiency, and popularity.

David Gill
Conservation International/George Mason University

Leveraging global datasets to identify human wellbeing impacts of marine conservation

Marine protected areas or parks (MPAs) are increasing used to conserve marine biodiversity and foster sustainable development around the world. Though the ecological benefits of MPAs are well documented, there is no consensus concerning their social impacts. Most of the information on MPA social impacts exist in local case studies, and the lack of consensus on how MPAs affect human wellbeing more broadly has led to contentious policy debates. Given the dearth of information on MPA social impacts beyond the local scale, this research seeks to leverage existing

national and global datasets (e.g. census data) to document shifts in human well-being associated with MPA establishment. Impact evaluation is used to measure the intended and unintended impacts of an intervention by comparing the observed outcomes against an estimate of what would have occurred in the absence of that intervention. By employing impact evaluation methods and global socioeconomic data, we seek to isolate t he causal impacts of MPAs upon various dimensions of human well-being including health, economic well-being, and educational attainment. As many countries continue to invest heavily in MPAs to meet national and international conservation objectives, understanding how coastal communities around the world are being affected by these interventions will provide valuable insights for evidence-based marine conservation policy and practice.

Tian Lin
University of Toronto

Climate change is undermining development and human wellbeing around the world, particularly in natural resource-dependent regions, including in Myanmar. Since 1995, the government of Myanmar has been supporting the development of community forestry (CF) to address deforestation and forest degradation, as well as meeting rural communities' subsistence needs. In recent years the government has also recognized the potential role of community forestry in climate change adaptation (Myanmar National Climate Change Strategy & Action Plan). Globally, few studies have examined the effectiveness of CF in improving people's ability to adapt to climate change. Using a sustainable livelihood assets framework to measure adaptive capacity, my research examines the contributions of CF to climate change adaptation in the dry zone of Myanmar.

My research suggests that the national CF program offers critical contributions to climate change adaptation, but faces a number of operational challenges that impede its effectiveness as an adaptation tool. While CF offers a platform for potentially vulnerable groups to increase their knowledge of land rights, the research revealed that overlapping land claims and legal ambiguities are hindering the implementation of CF. My research indicates that the practical challenges associated with CF implementation, highlights tensions between livelihood needs and conservation objectives, which may not always be synchronized in natural resource use policy. So, while CF presents many benefits in terms of community engagement with natural resource management and climate change adaptation, in the absence of tangible benefits to the community, the effectiveness of CF as a national program may be limited.

Lelani Mannetti
Stellenbosch University

Protected areas remain vital to global conservation efforts. To simultaneously improve biodiversity conservation and promote human well-being, protected areas cannot be considered separate from their surrounding landscapes. As such, protected areas and adjacent landscapes are increasingly being viewed as integrated. Planning for such multifunctional landscapes requires an understanding of the institutional context, since institutions serve as an interface between the social and ecological components of a system. Here, we assessed the institutional aspects (i.e. norms or rules-in-use) of including various land use practices around Etosha National Park in Namibia into an integrated conservation landscape. The present landscape provides s everal ecological benefits, including provisioning ecosystem services (pasturage and water) and cultural ecosystem services (hunting and tourism). Data on stakeholder perspectives and resource governance were obtained from semi-structured interviews conducted with park management, landowners, farmers and communal residents. We identified six distinct resource governance systems, each variably focused on ecosystem services and each guided by different institutions that shape stakeholder behavior. A broad repertoire of norms and shared strategies were found to be practiced in isolation from each other and constrained by land tenure. Expanding the protected area network requires integration of the different governance approaches and a landscape approach to management.

Karly Miller
University of California, Santa Barbara

The social and ecological importance of small-scale fisheries has come into focus in the past decade, with experts estimating that they account for up to 1/3 of global fisheries catches, employ 90% of fishers worldwide, and provide

50% of the seafood for human consumption. With this importance comes an interest in management, but the majority of small-scale fishers are located in rural and developing coastal regions, making conventional management tools particularly challenging. Integrated conservation-development strategies have gained popularity as a possible approach, where development - often via tourism - is seen as a way to reduce pressure on the resource by providing alternative livelihoods. Ideally, this is a win-win for conservation and community development, however the actual social and ecological outcomes of tourism development are highly variable. This raises the questions: what accounts for this variation? and is there an opportunity for management interventions to improve these outcomes? In this talk I will present a conceptual framework on the impact of tourism development on small-scale fishing; first looking at household-level response to tourism development in order to understand and anticipate changes in fishing at the community level, and then examining how household and community characteristics correlate to household-level decisions and community-level outcomes. This framework is based on ethnographic and household survey data from field work conducted between 2015-2017 in eight small fishing communities on the Pacific Coast of Colombia, where tourism began ~40 years ago but has developed in different ways and at different rates in each community.

Nicholas Oguge
University of Nairobi

Industrialization is a key pillar of economic growth and wealth creation in Kenya (GOK, 2013; 2016) as envisaged in the Kenya Vision 2030. This has encouraged the proliferation of manufacturing value added special economic zones (SEZs) across the country, with 50 currently gazetted. The existing model is, however, closely tracked by myriad challenges transcending environmental, social and economic domains; hence the need for adoption of resource eff iciency strategies and business model innovations (Nubholz, 2017). Amid finite resources, a circular economic model for industrial development would help de-link growth in resource consumption thereby offering the prospect of sustainability (Ghisellini et al., 2015). Given projections of the end of cheap nature raises questions about the potential redevelopment of reuse, and the shifting relationality of reuse to capitalist markets (Isenhour et al., 2017). To turn products into services demands holistic approach, involving economic growth, jobs, environment, development, and adoption of new technologies that would build resilience to this socio-economic system. The proposed study will develop knowledge and build capacity for adaptability and transformability in the Kenyan manufacturing sector that would generate evidence for policy on the circular economy and a framework for good practice strategies on waste prevention and reduction (Masi et al., 2017). The outcome will contr ibute to the sustainable development agenda at global (SDGs 8, 9 & 12), regional (AU Agenda 2063 priority1), and national (Kenya Agenda) levels.

Pranay Ranjan
Purdue University

Effects of Institutional and Infrastructure Designs on Collective-Risk Social Dilemmas in Socio-Hydrological System Dynamics: A Case of Agriculture Drainage System

Agriculture drainage systems involve collective-risk social dilemmas. Farmers need to invest in a public good (i.e., constructing and maintaining the system), not to realize a gain but to reduce the risk of potential inundation-related damages. Providing this public good requires individuals' contributions, with benefits to all but uncertainty that others will also contribute and whether or not the risk will be realized, leading to free-rider issues. To solve the dilemma, communities adopt institutions (rules and norms) to regulate farmers' decisions, which can be grouped into self-governance and agency-imposed governance regimes. This research aims to investigate how the long-term dynamics of behavioral strategies adopted by farmers (cooperate vs. defect) under these institutional regimes is influenced by drainage systems' physical characteristics (spatial asymmetries of farmers with respect to drainage ditch vs. uphill-downhill terrain difference). In one extreme, whe n both the asymmetry and uphill-downhill difference are high, the farmers located on upstream and uphill areas face a low risk of flooding and thus have little incentives to contribute to the public good. Can these physical and institutional characteristics interact to induce fundamental changes, i.e., regime shifts, in the dynamics of farmers' behavioral norms? We investigate this problem by developing and analyzing a simple model of collective action dynamics for drainage infrastructure provision. This model is used to demonstrate that the combined effects of physical and institutional design can indeed induce

such regime shifts and thus it is important to consider the "fit" between institutional design and underlying physical context to achieve sustainable outcomes.

Nestor Silva
Stanford University

In North Dakota's Bakken region, a globally-significant fracking oilfield, hydrocarbons and agriculture share geographic space and have done so since the early 1950s, the unintentional outcome of the Homestead Acts and North American paleogeology. While hydrocarbons are almost synonymous with environmental degradation, agriculture requires ecologically intact land, water, and air, meaning the juxtaposition of these industries poses a series of socio-environmental problems. Nonetheless, that juxtaposition is now intentional, designed, and is visible in the cultural and geographic landscapes of places like the small town of Tioga, site of my dissertation research. That research focuses on the sociocultural and ecological practices of people who live and work in spaces of joint hydrocarbon/crop production: farmers, oil and gas workers, agronomists, and government officials. Broadly, I study how culturally-meaningful modes of work and understandings of space are used to frame and negotiate the tensions and uncertainties inherent to joint hydrocarbon/crop production. My talk will analyze the design, construction, and maintenance of fracked wells and well sites set in Bakken farmland.

Culturally-meaningful modes of work, of scientific inquiry, and techniques of government all contribute to designing those wells and well sites. I argue that through those socio-environmental practices, the tensions and uncertainties inherent to joint hydrocarbon/crop production are mitigated and normalized. This allows farmers, oil workers, scientists, and officials to frame joint hydrocarbon/crop production as a lively, valuable, and intentional socio-environmental system, not simply some precarious arrangement. Effectively, their work converts wells, farms, and uncertainty into carefully-designed features of the Bakken landscape.