Symposium Schedule
Landscape networks as telecoupled human and natural systems
US-IALE 2016 meeting
Monday April 4, 2016, 1:40 – 5:20 pm

Organizers
Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University
Vanessa Hull, Center for Systems Integration and Sustainability, Michigan State University

Scheduled Talks

1:40 - 2:00 pm
Landscape networks as telecoupled human and natural systems: an introduction
  Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University,
  East Lansing, MI
  Vanessa Hull, Center for Systems Integration and Sustainability, Michigan State University,
  East Lansing, MI

Landscapes around the globe are becoming increasingly more tightly connected to other distant systems through flows of information, matter, energy, organisms, financial capital, and people. Traditional place-based approaches fall short of understanding, modeling, and managing for such complex global processes that cause immense landscape changes in the Anthropocene era. The new umbrella concept called "telecoupling" overcomes this shortcoming by explicitly analyzing socioeconomic and environmental interactions over distances. The telecoupling framework treats each landscape as a coupled human and natural system, and a network of landscapes as telecoupled human and natural systems. It analyzes the diverse agents, flows, causes, and effects of interactions between the distant systems. In this introduction to the telecoupling symposium, we explore applications of the telecoupling framework to address important issues relevant to landscape changes, such as distant supply of and demand for ecosystem services and natural resources, conservation, migration, international trade, and sustainability across local to global scales. We also highlight the capacity for the framework to detect and understand hidden mechanisms behind landscape changes, some of which arise due to "spillover" effects that occur when systems are indirectly impacted in surprising ways by interactions among other coupled systems. Examples include the diffuse spread of greenhouse gas emissions, cascading effects of trade on third-party players in global markets, and spread of invasive species at stopover nodes in global travel networks. We hope that this symposium will stimulate further research on this rapidly progressing frontier and provide useful information for more effective landscape management.

2:00 - 2:20 pm
A telecoupling model to account for spatial subsidies of ecosystem services provided by transboundary migratory species in North America
Laura López-Hoffman, School of Natural Resources & the Environment, The University of Arizona, Tucson, Arizona
Ruscena Wiederholt, Udall Center for Studies of Public Policy, The University of Arizona, Tucson, Arizona
John Loomis, Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, Colorado

In complex coupled natural-human systems, drivers of change in one location can have profound effects on human well-being in distant locations, often across international borders. While the conceptual framework of telecoupling describes these interactions across space, analytical approaches are necessary to quantify feedbacks between ecosystem change in one area and societal benefits in other areas. Here, we use a new approach—spatial subsidies—to operationalize the concept of telecoupling by measuring the degree to which a migratory species’ ability to provide services in one location depends on habitat in another location. We calculate spatial subsidies for two North American migratory species: Mexican free-tailed bats *Tadarida brasiliensis mexicana* and Northern Pintails *Anas acuta*. For each species, we model habitat distribution and dependence, and assess the economic value of ecosystem services provided by these species (pest control, and recreational and subsistence hunting, respectively). We then assess spatial subsidies under current conditions and global change scenarios of wind energy development and hunter declines. Our goal is to present managers with modeled scenarios of impacts on services and spatial subsidies to identify how they might alter land-use and conservation actions in response, and understand how the spatial subsidies concept might support the objectives of international cooperation to protect migratory species.

2:20 - 2:40 pm
Feedback effects of telecoupling: The case of a payment for ecosystem services program
Hongbo Yang, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI
Frank Lupi, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI
Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI

Over the last half century, remote rural areas are increasingly connected by telecouplings (i.e., environmental and socioeconomic interactions over distances) such as tourism, labor migration, and payments for ecosystem services (PES) programs. This trend has profoundly affected natural resource use in many rural areas and has generated complex effects on landscape changes around the world. However, existing literature rarely elucidates the feedback effects of telecouplings, e.g., how landscape changes caused by telecouplings will in turn strengthen or weaken the telecouplings themselves. Considering feedback effects is critically important for the design and management of telecouplings as feedbacks may generate unexpected outcomes. Ignoring them may lead to biased estimates of the long-term effects of telecouplings and information for management decisions. To address this knowledge gap, we used biophysical and socioeconomic data collected in China’s Wolong Nature Reserve for giant pandas
(Ailuropoda melanoleuca) to empirically evaluate the feedback effects of one of the largest PES programs in the world — the Grain-to-Green Program (GTGP), which converts crop land to forest land or grassland. We found the landscape changes in Wolong caused by GTGP have significantly intensified the local human-wildlife conflicts (e.g., crop raiding) on the remaining cultivated crop land. The intensified human-wildlife conflicts in turn have significantly increased people’s willingness to participate in similar PES programs in the future to avoid more crop damage. Our findings suggest that evaluating telecouplings should properly quantify the feedback effects to achieve reliable results and design effective policy interventions.

2:40 – 3:00 pm
Spillover network of multiple telecouplings

Zhiqiang Zhao, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI
Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI

Spillover systems are the least understood components of telecoupled human and natural systems. Here we address spillover systems based on a recent integrated study which shows that there are multiple telecouplings between Wolong Nature Reserve in China (a high-profile nature reserve for the world-famous endangered giant pandas) and the rest of the world (Liu et al. 2015). Results show that those telecouplings have spillover effects on 67 other nature reserves for giant pandas. As the other nature reserves are also ecologically and socioeconomically connected directly and indirectly, they constitute a spillover network. Wolong has flows (of pandas, tourists, and information) with the spillover network and shares the supply of and demand for ecosystem services, conservation subsidies, and agricultural and industrial products. Through analyzing other components (agents, causes, and effects) of the spillover network under the telecoupling framework, we have found that there are a diverse set of agents, ranging from government agencies, reserve staff, non-governmental organizations, local residents, to researchers. The causes behind the spillover flows consist of several factors, such as the exceptional support for Wolong from the Chinese government and the international community. There are both socioeconomic and ecological effects, including community development, management skill improvement, and forest changes. This study contributes to a better understanding of the telecoupled world and has significant implications for reserve management and sustainability policy.

<coffee break 3:00 - 3:20 pm>

3:20 - 3:40 pm
A telecoupling analysis for the Patagonian shelf: new international perspectives towards ocean sustainability

Andrea Raya del Rey, National Scientific and Technical Research Council, Buenos Aires, Buenos Aires F.D., Argentina
Falk Huettmann, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AL
The Southwest Atlantic Ocean and the extended Patagonian shelf in particular, is a highly productive seascape. It is a very complex ecosystem of global relevance and maintains a great diversity and abundance of seabirds and marine mammals, too. Fisheries have been identified as a main stressor for the marine ecosystems and as the main cause of seabird population declines. Using the framework of telecoupling - the sophisticated natural and socioeconomic interactions over wider distances - we present a fresh look at the dynamic fisheries and (endangered) seabird interactions for the Patagonian Shelf seascape. We found that these waters are affected by many nations and players, inside and outside. Here we show how the input, output and spill-over of the Patagonian shelf ecosystem are distributed almost globally. In addition, we also show ‘losers’ (=nations that are left out entirely from this global resource and its governance). Our findings are based on best available public trade and harvest analysis for this region, linked with predictive modeling (machine learning and some open source geographic information systems GIS) for nine seabird species. We extend this analysis with a perspective from the financial sector and ethical banking policy that support the Patagonian fisheries as international investment projects. As increasingly recognized elsewhere, we believe that telecoupling can serve as a new but rather sophisticated study template for an improved more holistic conservation research on oceans and global sustainability questions.

3:40 - 4:00 pm
Assessing the effectiveness of a payments for ecosystem services program with telecoupling framework

Tao Pan, Key Laboratory of Land Surface Pattern and Simulation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China
Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI

Assessing the environmental and socioeconomic effects of payments for ecosystem services (PES) programs can help design effective policy to sustain ecosystem services and improve human well-being. However, most of the existing assessments were place-based and ignored that the provision of, and demand for, ecosystem services, are often spatially segregated. Here we apply an integrated framework of telecoupling to assess the effectiveness of a major PES program (the Ecological Protection and Construction Project that aims to protect and restore grasslands) in the Three-River Headwaters National Nature Reserve (TRHNNR), China’s largest nature reserve. Results show that there are several telecouplings (e.g., provision of clean water, trade of agricultural products, tourism, investments of PES program, and knowledge dissemination). These telecouplings connect not only the upstream and downstream regions of the three river basins but also other regions of China and the world. They have both positive and negative impacts. After the first phase of PES program implementation from 2005 to 2013, the water supply service increased significantly as the grassland degradation is better controlled. The recreation service also has increased, which has led to increases in both domestic and international tourists. TRHNNR has gained national and international attention through the news media, publication of books and articles, and visitors. Yet not all effects have been positive. For example, livestock has been reduced, negatively impacting the livelihood of local herders. This integrated assessment provides a comprehensive understanding of payments for ecosystem services programs and has significant implications for future policy making.

4:00 - 4:20 pm
Telecoupled interactions among tourism, ecosystem services, and human well-being
Tourism is a telecoupling process that provides physical and psychological benefits to human well-being across local to global levels. It has grown rapidly worldwide. For example, the contribution of tourism to the total GDP in Qinghai Province of China experienced a 4-fold increase between 1999 and 2014. However, it is not clear how increased tourism affects ecosystem services and local livelihood. The purpose of this research is to apply the integrated telecoupling framework to understand the complex interactions among tourism, ecosystem services, and human well-being in Qinghai Province. Our results indicate that the increased number of visitors boosts local income, accelerates the development of tourism infrastructure, and exacerbates natural habitats. More local people have participated in tourism industries to receive direct and indirect benefits: working in travel agencies, working temporarily on infrastructure construction, and selling local agricultural products to tourism industries. The interactions between tourism and local people may have a positive feedback, and therefore lead to increases in both agricultural products and tourism development. Also, tourist water consumption and carbon emissions affect people and the environment locally and globally. This research can provide guidelines for new payments for ecosystem services to sustain ecosystems and enhance livelihood simultaneously.

4:20 - 4:40 pm
Telecouplings of limited resources: the case of sand

Aurora Torres, Museo Nacional de Ciencias Naturales, Spanish Research Council (MNCN-CSIC), Madrid, Spain
Jodi Brandt, Human-Environment Systems Program, Boise State University, Boise, ID
Kristen Lear, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA
Gabriel Zegers, Ecosystems and Environment Department, University of Santiago, Chile

Telecouplings are socioeconomic and environmental interactions over distances. Sand is mined worldwide for many uses and accounts for the largest volume of solid material extracted globally, making sand mining and trade an important telecoupling. Sand is extracted at a rate far greater than its renewal and is therefore a limited resource. Historically, extraction was from inland deposits. However, declines of these deposits have caused a shift to coastal sand mining. Coastal sand extraction has immense effects on natural and social systems in sending systems, including impacts on biodiversity, erosion, and tourism. Receiving systems are also impacted via introduction of invasive species and diseases. Furthermore, sand trade has spillover effects, such as exacerbating climate change due to carbon dioxide emissions from sand transportation. The increasing demand for sand will likely increase conflicts and potentially lead to a “tragedy of the sand commons”. The sheer scale of these problems and the complex web of jurisdictional boundaries make it difficult to assess this issue from a traditional perspective. Therefore, we
apply the telecoupling framework to untangle the complex interlinkages resulting from sand mining and trade. Our goals are to (1) describe the problem of sand mining and trade, (2) identify actors and analyze their interconnections, and (3) identify current and future threats of this issue to the sustainability of telecoupled systems. We present a conceptual model of sand mining and trade in which we highlight the global dimension of the problem, the flows associated with the resource, and links to other sustainability challenges.

4:40 – 5:00 pm
Telecoupled food trade drives farmer risk perception

Anna Herzberger, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI
Jing Sun, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI
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In the past several decades, international trade has increased rapidly, connecting producers and consumers and environments across the globe. For example, there are increasing amounts of soybeans being exported from Brazil and the United States to meet rising demands in China. As soybean imports in China continue to increase, remote sensing research and Chinese national statistics have revealed that China’s traditional primary soybean producing region, Heilongjiang Province, is decreasing in soybean area planted. Using the telecoupling framework as a guide and data from household surveys conducted in the region, our findings suggest that international soybean imports influence risk perceptions of farmers in Heilongjiang. Less affluent farmers perceived imports as more of a threat to their market crop prices, as they were more financially vulnerable (i.e. subject to more risk). Farmers use their risk perceptions to inform future cultivation decisions, which in turn affect cultivation patterns across landscapes. The telecoupling framework provides a systematic way of analyzing how risk perceptions are driven by international soybean imports and how that perception influences cultivation decisions.

5:00 - 5:20 pm
Applying the telecoupling framework through the lens of landscape ecology

Dorothy Maguire, USDA-ARS, European Biological Control, Montpellier, France
Danica Schaffer-Smith, Nicholas School of the Environment, Duke University, Durham, North Carolina
Stephanie Tomscha, Forest and Conservation Sciences, Faculty of Forestry, University of British Columbia, Vancouver, British Columbia
Michael Treglia, Department of Biological Science, University of Tulsa, Tulsa, OK
Jianguo Liu, Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI

Interactions among humans and natural ecosystems are complex, occurring not just locally, but across various spatial scales. The telecoupling framework is useful for characterizing these
connections, both within and across social-ecological systems. Understanding these relationships is critical for long-term management in our globalized society, particularly with potential for changing commodities with climate change. However, empirical work on quantifying coupled human and natural systems, let alone telecoupled systems, is in its relative infancy, as these relationships can be overwhelmingly complex. We suggest that Landscape Ecologists are well-suited for addressing this issue, given their expertise in considering humans and natural resources, and spatio-temporal dynamics, across multiple scales to understand relationships between emergent patterns and underlying processes. Thus, we present a suite of techniques from landscape ecology, and illustrate, conceptually, how they can be applied in understanding relationships among agents in the global soy market, with an emphasis on Brazil and China. We highlight how available datasets may be used with specific analytical methods towards understanding this complex system, and explain how the results can feed into understanding other linkages, ultimately yielding a fairly complete representation of the system.