

ABSTRACTS

Institutions, Infrastructure, and the Environment: Tracking institutional change in urban water management

Sara Hughes

The institutions designed to secure and deliver urban water supplies stretch a city's footprint far beyond its boundaries, and as such these institutions are often ill-equipped to account for the environmental consequences of infrastructure decisions. Experience shows that too often urban water infrastructure negatively impacts ecosystems and ecosystem services, compromising long-term water supplies and causing political and social conflict. I propose that these negative impacts are evidence of "institutional misfit," and argue that theory predicts institutional misfit will encourage institutional change because of the inherent conflict and excluded interests that come with misfit. However, if and when institutional change does take place in the case of urban water infrastructure, how does it happen? For my dissertation research I divide this question into three parts: 1) What is the pattern of institutional change observed—is it *evolutionary* or *revolutionary*; 2) What are the mechanisms through which change takes place; and 3) What are the outcomes of change. To explore these questions further, I will use the case of the Hetch Hetchy System that supplies the greater San Francisco area, and particularly focus on O'Shaughnessy Dam. Evidence of a lack of fit can be seen in the continual decline of fish populations in downstream river reaches since dam construction and conflict surrounding its existence and management. I will provide some early results describing the pattern of change, mechanisms of change, and outcomes of change that can be observed in this system, and discuss their potential for understanding environmental institutions.

Voluntary Provision of Environmental Goods: Clubs & Market Structure

Laura Grant

Economic activities often create externalities of environmental degradation. Many policies attempt to redress these problems, including command-and-control regulation such as technology requirements, quotas, and taxes/subsidies. A recent resurgence in social responsibility research studies an alternative institutional remedy: voluntary contributions to public goods where various donors, firms, and organizations take voluntary measures to abate environmental destruction or contribute to public programs. Although the theory of free-riding suggests an undersupply of public goods in the market, voluntary contributions to public amenities exist, none-the-less. The green movement promotes sustainable production and encourages purchases of these products.

Yet, certification standards for environmental practices and production are common and important threshold parameters. Producers have a vested interest in the level of green production and the costs associated. Does market structure influence endogenous threshold setting of the standards? Do first-movers have payoff advantages in green clubs? Providing a motivating anecdote, the fair trade coffee industry indicates above market-wages, sustainable production, and social contributions to the communities that grow the good. Starbucks Coffee Co played a strong role in set the minimum standards for Fair Trade Certification. Other examples of first-mover behavior occur in carbon self regulation by Walmart, GE, Dupont, and Goldman Sachs; sustainable forest products by Home Depot; and recycled paper content by Staples. This research alters the basic models to accommodate various structures of market power, ranging from imperfect competition to a Stackelberg leader and assessing club formation, club standards and the subsequent environmental goods provision.

The Role and Value of Information for Supply Loop Management: Framework and Application

Vered Doctori-Blass

The economic and environmental benefits of reuse and recycling, i.e. circular supply loops rather than linear supply chains, have been widely researched in recent years. Although theoretically promising, relatively few recycling and reuse activities are in practice self-sustaining without government intervention. This does not reflect the poor potential of resource cycling, but rather indicates the barriers for implementation of such systems. In this research we combine the principles and methods of industrial ecology, information, and management science to investigate the role and value of information for product end-of-life (EoL) management. We propose an evaluation method for the Value of Information, and quantify the economic and environmental values of the relevant information for decision making. We provide a tool to assess the benefit of tracking relevant information, and its effect on the entire EoL supply loop performance. Lastly, we demonstrate the application of our tool using the case study of EoL cell phones.

Land Cover Change Related to Residential Housing Development in the U.S. from 1990 – 2000

Patrick Jantz

Habitat loss from conversion to urban and agricultural uses is a major threat to biodiversity globally. In the U.S., habitat loss was identified by a majority of state fish and game departments as a primary concern and is a leading cause of species endangerment. Currently, most land cover conversion in the U.S. results from residential housing growth, commercial development, and associated road building. Nationwide from 1990-2000, almost 250,000 miles of paved road and over 13.5 million housing units were constructed.

To understand how recent trends in housing development affect habitat, it is crucial to establish how rates of conversion to anthropogenic uses and types of lands affected vary across the U.S. For example, while most of the Chesapeake Bay Watershed in the Eastern U.S. is forested, agricultural lands were preferentially developed from 1990 – 2000. However, in the Piedmont ecoregion, which runs from the Chesapeake Bay southwest to Alabama, forested lands were disproportionately converted for development from 1973 – 2000, reaching a maximum rate from 1992 – 2000.

Several studies have assessed land use and land cover dynamics in various regions of the U.S. by combining satellite imagery or aerial photography with GIS data. However, because of a lack of consistent national land cover maps for more than one time period, assessments were either restricted to a single time period or change maps were independently developed for small areas.

Recently, a nationally consistent map of Anderson Level I land cover change from 1992-2001 for the contiguous U.S. was made available through the U.S.G.S National Land Cover Database (NLCD) program. We use geographically weighted regression (GWR) to compare changes in U.S. Census Bureau derived housing development with changes in NLCD derived land cover from 1990 – 2000 and to assess how that relationship varies regionally due to heterogeneity in land cover, existing housing density, and biophysical and economic characteristics.

To understand the limits of the NLCD map, we compare it with independently derived impervious surface change maps from three areas of the country. Results indicate that the NLCD change product provides conservative estimates of conversion to urban uses, with mapped changes corresponding to impervious surface increases of at least 40%.

Avalanche Crown Depth Distributions

Ned Bair

Other researchers have suggested that crown depths follow either a scaling distribution (Birkeland and Landry, 2002; Faillettaz et al., 2004; Rosenthal and Elder, 2003) or a lognormal distribution (McClung, 2003; 2005). A variety of generating mechanisms have been proposed including: Self-Organized Criticality (Birkeland and Landry, 2002; Faillettaz et al., 2004; Louchet et al., 2002), chaotic processes (Rosenthal and Elder, 2003), and

components of fracture toughness, including fracture size, creep, bonding and crack propagation (Heierli et al., 2008; McClung, 2005). We test seven distributions on two large avalanche crown depth datasets, from Mammoth Mountain, CA and from the entire Westwide Avalanche Network, to determine which fits best.

The generalized extreme value distribution provides a robust fit on path and area scales for crown depths above 30.5 cm at Mammoth Mountain. The most parsimonious explanation is neither self-organized criticality nor other complex cascades, but maximum domain of attraction; that is the maximum crown depth, not the average, is most commonly recorded. This recording bias generates scaling or power law distributions. More field observations on avalanche crown faces are needed to investigate whether individual avalanche crown face depths are scaling. Given the highly variable nature of snow depth, this result would not be surprising.

We also show that avalanches do not have a universal tail index. Rather, they range from 2 to 4 over different avalanche paths, consistent with other geophysical phenomena such as wildfires, which show similar variability (Malamud et al., 2005). We urge practitioners to record crown depth at multiple locations on crown faces. Last, we suggest using extra caution on stubborn paths, which can be identified by their low tail indices.

Understanding the Transfer of Volatile Chemicals Across Air-Water Interfaces

Damon Turney

Transfer of volatile chemicals at air-water interfaces is an important process for the fate and transport of many environmental pollutants and nutrients. Current methods for predicting, measuring, or understanding this process are fraught with uncertainty. This talk will give an overview of these current methods and then offer new experimental and theoretical findings to show that the process is well described by the advection-diffusion equation so long as the advection term is constructed solely from the upwelling and downwelling motions within a millimeter of the interface. These findings place added scientific confidence into our understanding of the process and suggest new methods for predicting and measuring the process.

Validation of Fractional and Binary Snow-Mapping Algorithms

Karl Rittger

Mapping snow cover from multispectral sensors began with a simple normalized index using visible and near infrared wavelengths to classify pixels as either snow covered or snow free, a “binary” classification.

Using a canopy reflectance model and incorporating a vegetation index into the binary algorithm achieved improvement. Although the binary snow mapping methods are computationally simple, they are in practice flawed because sensors with fine spatial resolution usually have a coarse temporal resolution, and vice versa. For sensors with fine enough temporal resolution to track the dynamic seasonal snow environment, few pixels are either completely snow covered or completely snow free.

Methods to estimate snow cover have progressed during the EOS era giving us the ability to determine the fraction of the pixel covered with snow.

In addition to binary methods, fractional methods include: decision tree classifiers, relationships of snow cover to snow index developed using regressions with higher resolution data, and spectral un-mixing.

Finally, daily data can be interpolated to produce a best estimate of snow cover. Here, we compare snow cover retrievals from binary and fractional snow cover algorithms using various satellites at fine and moderate resolution: MODIS (500m), Landsat (30m) and ASTER (15m). For binary snow cover we use both NDSI and NDSI with vegetation correction.

For fractional snow cover we use a currently implemented operation algorithm MOD10A1 and our own estimates from MODSCAG spectral un-mixing.

For best estimates of snow cover we use another operational algorithm, MOD10A2 and our own reanalysis of MODSCAG fractional snow cover. The main study area is the Sierra Nevada of California. We find that fractional methods are superior to binary methods. Moreover, we find that linear spectral un-mixing gives the

best estimates of snow cover at moderate resolution over other fractional products. . Space-time interpolation of retrievals from MODSCAG gives the best estimates of snow cover when compared to MOD10A2. Finally, space-time interpolation and MODSCAG perform similarly when MODIS is near nadir, but for off nadir geometry space-time interpolations give the best estimates of snow cover.

Natural organic matter removal by coagulation and nanoparticle adsorption

Hongtao Wang

Nanoparticles are supposed to have significant potential in water treatment. To investigate the possibility of using nanoparticles as adsorbents for water purification, carbon black was employed to remove natural organic matter (NOM) in water in the presence and absence of coagulation. In the absence of coagulation, more than 60% NOM removal was achieved by carbon black adsorption. Lower pH (3~5) was favorable for NOM removal. More than 35% NOM was removed by carbon black adsorption in the first 20 minutes, and the adsorption of NOM onto carbon black could be finished within about 2 hours. Proper stirring was essential for the mixture of NOM and carbon black, while insufficient stirring or overstirring decreased the NOM removal efficiency. When low dosages of coagulants were used to remove NOM at pH 6, carbon black improved the removal effectively. The sequence of adsorption and coagulation influenced the NOM removal. Carbon black should be added before coagulant or simultaneously so as to ensure enough contact time. About 70% NOM was removed in 15minutes by carbon black adsorption and alum coagulation. This study indicated that carbon black might be an important adsorbent for NOM removal in the water treatment process.

Growth and survival of an artisanally harvested giant clam (*Tridacna maxima*)

Annie Yau

An important challenge in the management of many small-scale fisheries is a lack of basic biological and ecological data on harvested species. Small-scale, artisanal fisheries still exist worldwide and are important food sources for local consumption. Although giant clams (Tridacnidae) are extensively aquacultured and harvested throughout the Indo-Pacific, almost no data on natural demographic rates exists. In Mo'orea, French Polynesia, the small giant clam *Tridacna maxima* is still harvested for local consumption. This fishery is managed with a size limit (120 mm) and spatial closures. To better understand the population dynamics of this managed population, individual clams at 12 different sites have been tracked through time since 2006. Spatial and temporal patterns of growth, survival, and recruitment will be presented. An analysis of the biotic and abiotic factors affecting survival and growth will be performed. Fishermen catch is characterized by measuring discarded shell piles. The population structure of Mo'orea is compared to that of Tetiaroa, a neighboring atoll with minimal fishing pressure. The paucity of live legal size clams on Mo'orea compared to Tetiaroa and abundance of below-legal size shells in fishermen catch suggest that the population of *T. maxima* on Mo'orea is overfished.

A Demonstration of Bioswales and Biotrenches for Treating Agriculture Runoff

Kristin Clark

Increases in the levels of pesticides and nutrients in the Santa Clara River threaten the uses of this watershed. The Santa Clara River is classified as a medium priority for the ammonium and nitrite/nitrate nutrient load in the TMDL program. This research project will investigate the use of two systems for the treatment of agriculture runoff in Reach 3 of the Santa Clara River. The systems are a series of bioswales measuring two feet deep, ten feet across and 165 feet long, and two bioactive trenches filled with straw bales to provide a permeable reactive barrier. Efficiency of the bioswales and bioactive trenches under different operating conditions will be monitored and the results reported to the FSCR and LA Regional Water Quality Board. It is expected that 95%

of the pesticides and nutrient loads will be reduced by a combination of the microorganisms, the plants, and adsorption to clay particles.

Carnivores in Working Landscapes: Avocado Orchards as Habitat

Theresa Nogeire

Agricultural activities are one of the leading drivers of habitat loss, but many species are able to persist and even thrive in agricultural landscapes. This effect is important when considering area-hungry habitat generalists such as mammalian carnivores: these animals have large home ranges, and they can and do use agricultural landscapes. As primary habitat for carnivores is lost or becomes increasingly fragmented, it is important to understand to what extent farmlands are contributing to or detracting from their persistence. Mid-sized mammalian carnivores are frequently conservation targets themselves, but they also play a key role in food webs and affect the persistence of other species. Avocado orchards are an important but under-recognized habitat type in southern California and avocados are a food resource for many omnivores, including coyote, bear, and gray fox. The orchards are also used by bobcats and mountain lions. I used remotely triggered cameras to find the probability of occurrence in avocado orchards in Santa Barbara and Ventura Counties. Using digital land use/land cover data I characterized the extent and configuration of natural, farm, and urban lands around surveyed sites. I found all native species except badgers and ringtails in avocado orchards. Bobcats, coyotes and gray fox are associated with high levels of avocado in their home ranges. I also trapped for rodents in orchard and control sites. I found much higher abundance of woodrats and mice in natural vegetation than in avocado orchards, but I was not able to trap black rats, rabbits, and fossorial rodents.