

Upcoming Events

F&ES Seminar Lecture Series: Tony Leiserowitz

Facts, Feelings, and Frames in Public Responses to Climate Change

12:00-1:00, Wednesday, Oct 26, 2011. Burke Auditorium, Kroon Hall.

Anthony Leiserowitz, Ph.D. is Director of the Yale Project on Climate Change Communication and a Research Scientist at the School of Forestry and Environmental Studies at Yale University. He is a widely recognized expert on American and international public opinion on global warming, including public perception of climate change risks, support and opposition for climate policies, and willingness to make individual behavioral change. His research investigates the psychological, cultural, political, and geographic factors that drive public environmental perception and behavior. He has conducted survey, experimental, and field research at scales ranging from the global to the local, including international studies, the United States, individual states (Alaska and Florida), municipalities (New York City), and with the Inupiaq Eskimo of Northwest Alaska. He also conducted the first empirical assessment of worldwide public values, attitudes, and behaviors regarding global sustainability, including environmental protection, economic growth, and human development. He has served as a consultant to the John F. Kennedy School of Government (Harvard University), the United Nations Development Program, the Gallup World Poll, the Global Roundtable on Climate Change at the Earth Institute (Columbia University), and the World Economic Forum.

F&ES Seminar Lecture Series: Reid Lifset & Matthew Eckelman

Teaching Environmental Management Using New Media:

Virtual Facility Tours of the Elihu Pulp & Paper Mill

12:00-1:00, Wednesday, Nov 2, 2011. Burke Auditorium, Kroon Hall.

Second Life is a virtual, open-access, and user-generated environment that has served as a platform for hosting everything from rock concerts to scientific conferences. Many institutions have also used Second Life as an educational tool, for example by, showcasing scientific exhibits or embedding video and images for learning purposes. During this talk we'll walk through the creation and use of an interactive, virtual industrial facility—the Elihu Paper Company—as a way to complement a traditional facility tours in F&ES courses in industrial environmental management. Virtual facilities offer a number of educational advantages over real-life ones: they are always open and available for tours, they can be accessed instantaneously from anywhere where there is an adequate internet connection, and most importantly, tours and embedded information can be tailored to specific educational objectives. Our experience in using Elihu Paper as a formal facility visit for the past several years shows that students had significantly more time than usual to ask questions, could and did explore the facility independently, and were still able to produce facility reports that fulfilled the educational objectives of the visits, including mapping material flows and explaining pollution prevention and sustainability opportunities.

Journal Publications

Exploring the dynamics of migration to mega-delta cities in Asia and Africa: Contemporary drivers and future scenarios

Authors : Karen Seto

Published: 2011, Global Environmental Change, in press.

Abstract: This paper examines key social and policy drivers of migration to cities in 11 Asian and African mega-deltas. The analysis shows that migration to urban centers in mega-deltas is an outcome of many forces: economic policies and incentives, local and destination institutions, government policies to develop small towns, and the geographic concentration of investments. Massive influx of capital to many deltas has transformed the local economic base from a primarily agricultural one to a manufacturing and processing economy. This has created uneven spatial economic development which is the underlying driver of migration to cities in the mega-deltas regardless of geographic context or size. Going forward to 2060, one critical challenge for all the deltas is to increase the labor skill of their workforce and foster technology innovation. Continued economic growth in these regions will require substantial investments in education and capacity building and the ability of urban centers to absorb the migrant labor pool.

Co-occurrence Patterns of the Dengue Vector *Aedes aegypti* and *Aedes mediovittatus*, a Dengue Competent Mosquito in Puerto Rico

Authors: Eliza Little, Roberto Barrera, Karen C. Seto, and Maria Diuk-Wasser.

Published: 2011, EcoHealth, DOI: 10.1007/s10393-011-0708-8

Abstract: *Aedes aegypti* is implicated in dengue transmission in tropical and subtropical urban areas around the world. *Ae. aegypti* populations are controlled through integrative vector management. However, the efficacy of vector control may be undermined by the presence of alternative, competent species. In Puerto Rico, a native mosquito, *Ae. mediovittatus*, is a competent dengue vector in laboratory settings and spatially overlaps with *Ae. aegypti*. It has been proposed that *Ae. mediovittatus* may act as a dengue reservoir during inter-epidemic periods, perpetuating endemic dengue transmission in rural Puerto Rico. Dengue transmission dynamics may therefore be influenced by the spatial overlap of *Ae. mediovittatus*, *Ae. aegypti*, dengue viruses, and humans. We take a landscape epidemiology approach to examine the association between landscape composition and configuration and the distribution of each of these *Aedes* species and their co-occurrence. We used remotely sensed imagery from a newly launched satellite to map landscape features at very high spatial resolution. We found that the distribution of *Ae. aegypti* is positively predicted by urban density and by the number of tree patches, *Ae. mediovittatus* is positively predicted by the number of tree patches, but negatively predicted by large contiguous urban areas, and both species are predicted by urban density and the number of tree patches. This analysis provides evidence that landscape composition and configuration is a surrogate for mosquito community composition, and suggests that mapping landscape structure can be used to inform vector control efforts as well as to inform urban planning.

Global climate impact of civil aviation for standard and desulfurized jet fuel

Authors: Nadine Unger

Published: 2011, Geophysical Research Letters, 38, L20803, doi:10.1029/2011GL049289.

Abstract: Aircraft emissions can affect climate change through increasing carbon dioxide (CO₂) but also via a host of other short-lived non-CO₂ effects that are complex, involve impacts that are both warming and cooling and are unique to this sector. Previous assessments of aviation climate impacts have used a segmented approach whereby each effect was calculated separately and the effects summed. Integrated approaches using newly available Earth System models that allow simulation of more realistic interactions between effects are now possible. The NASA GISS Earth System Model (Model E) is applied to reassess the net climate impact of civil aviation emissions based on a new inventory for year 2006 developed using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT). The model simulates all known aviation climate impacts except linear contrails and contrail-cirrus for which a recent estimate is assumed. For standard jet fuel, the net global climate impact for sustained constant year 2006 aviation emissions is $+44 \pm 10$ mWm⁻² (2/3 due to non-CO₂ effects) on a 20-year timescale and $+73 \pm 10$ mWm⁻² (over 1/3 due to non-CO₂ effects) on a 100-year timescale. For desulfurized jet fuel, the net climate impact is $+40 \pm 10$ mWm⁻² on the 20-year timescale, slightly less warming than the standard fuel case due to the complex interplay between sulfate and nitrate and the competition for ammonia. Ozone (O₃) greenhouse efficiency (W per g O₃ change) is 20-60% larger for aviation than surface transportation emissions.

Uncovering the Global Life Cycles of the Rare Earth Elements

Authors: Xiaoyue Du and Thomas E. Graedel

Published: 2011, Nature Scientific Reports, in press.

Abstract: The rare earth elements (REE) are a group of fifteen elements with unique properties that make them indispensable for a wide variety of emerging, critical technologies. Knowledge of the life cycles of REE remains sparse, despite the current heightened interest in their future availability. Mining is heavily concentrated in China, whose monopoly position and potential restriction of exports render primary supplies vulnerable to short and long-term disruption. To provide an improved perspective we derived the first quantitative life cycles (for the year 2007) for ten REE: lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), and yttrium (Y). Of these REE, Ce and Nd in-use stocks are highest; the in-use stocks of most REE show significant accumulation in modern society. Industrial scrap recycling occurs only from magnet manufacture. We believe there is no post-customer recycling of any of these elements.

The effect of resource history on the functioning of soil microbial communities is maintained across time

Authors: Ashley D. Keiser, Michael S. Strickland, N. Fierer, and Mark A. Bradford

Published: 2011, Biogeosciences, 8: 1477-1486.

Abstract: Historical resource conditions appear to influence microbial community function. With time, historical influences might diminish as populations respond to the contemporary environment. Alternatively, they may persist given factors such as contrasting genetic potentials for adaptation to a new environment. Using experimental microcosms, we test competing hypotheses that function of distinct soil microbial communities in common environments (H1_a) converge or (H1_b) remain dissimilar over time. Using a 6 × 2 (soil community inoculum × litter environment) full-factorial design, we compare decomposition rates in experimental microcosms containing grass or hardwood litter environments. After 100 days, communities that develop are inoculated into fresh litters and decomposition followed for another 100 days. We repeat this for a third, 100-day period. In each successive, 100-day period, we find higher decomposition rates (i.e. functioning) suggesting communities function better when they have an experimental history of the contemporary environment. Despite these functional gains, differences in decomposition rates among initially distinct communities persist, supporting the hypothesis that dissimilarity is maintained across time. In contrast to function, community composition is more similar following a common, experimental history. We also find that ‘specialization’ on one experimental environment incurs a cost, with loss of function in the alternate environment. For example, experimental history of a grass-litter environment reduced decomposition when communities were inoculated into a hardwood-litter environment. Our work demonstrates experimentally that despite expectations of fast growth rates, physiological flexibility and rapid evolution, initial functional differences between microbial communities are maintained across time. These findings question whether microbial dynamics can be omitted from models of ecosystem processes if we are to predict reliably global change effects on biogeochemical cycles.

Nitrogen uptake and preference in a forest understory following invasion by an exotic grass

Authors: Fraterrigo, J.M., Michael S. Strickland, Ashley D. Keiser, and Mark A. Bradford

Published: 2011, Oecologia, 167:781-791.

Abstract: Plant–soil interactions have been proposed as a causative mechanism explaining how invasive plant species impact ecosystem processes. We evaluate whether an invasive plant influences plant and soil-microbe acquisition of nitrogen to elucidate the mechanistic pathways by which invaders might alter N availability. Using a 15N tracer, we quantify differences in nitrogen uptake and allocation in communities with and without *Microstegium vimineum*, a shade-tolerant, C4 grass that is rapidly invading the understories of eastern US deciduous forests. We further investigate if plants or the microbial biomass exhibit preferences for certain nitrogen forms (glycine, nitrate, and ammonium) to gain insight into nitrogen partitioning in invaded communities. Understory native plants and *M. vimineum* took up similar amounts of added nitrogen but allocated it differently, with native plants allocating primarily to roots and *M. vimineum* allocating most nitrogen to shoots. Plant nitrogen uptake was higher in invaded communities due primarily to the increase in understory biomass when *M. vimineum* was present, but for the microbial biomass, nitrogen uptake did not vary with invasion status. This translated to a significant reduction ($P < 0.001$) in the ratio of microbial biomass to plant biomass nitrogen uptake, which suggests that, although the demand for nitrogen has intensified, microbes continue to be effective nitrogen competitors. The microbial biomass exhibited a strong preference for ammonium over glycine and nitrate, regardless of invasion status. By comparison, native plants showed no nitrogen preferences and *M. vimineum* preferred inorganic nitrogen species. We interpret our findings as evidence that invasion by *M. vimineum* leads to changes in the partitioning of nitrogen above and belowground in forest understories, and to decreases in the microbial biomass, but it does not affect the outcome of plant–microbe–nitrogen interactions, possibly due to functional shifts in the microbial community as a result of invasion.

Sustainability and Commerce Trends, Industry Consortia as the Drivers for Green Product Design

Authors: Golden, J. S; Subramanian, V.; Julie B. Zimmerman

Published: 2011, Journal of Industrial Ecology.

Advanced article published online: <http://dx.doi.org/10.1111/j.1530-9290.2011.00381.x>

Abstract: Despite the current political climate in Washington, it is clear that the 2nd decade of the 21st century has brought with it increased interest and proactive engagement by the US business community and federal government to transition from firm and facility sustainability to more holistic focus on product sustainability throughout the value chain. Although many of the efforts are not systematic or coordinated, a description of them indicates that individual organizations are recognizing their responsibility to address sustainability challenges.

Derivation and synthesis of renewable surfactants

Authors: Foley, P. M.; Kermanshahi pour, A.; Beach, E. S.; Julie B. Zimmerman

Published: 2011, Chemical Society Reviews.

Advanced article published online <http://dx.doi.org/10.1039/C1CS15217C>

Abstract: This *critical review* focuses on the origins and preparation of bio-based surfactants, defined here as non-soap, amphiphilic molecules in which the carbon atoms are derived from annually renewable feedstocks. Environmental concerns and market pressures have led to greater relevance of these chemicals in commercial applications in recent years and extensive research has gone into exploring new classes of surfactants. Highlighted here are examples of bio-based surfactants that are produced on an industrial scale and/or are based on abundant starting materials. The trend of increasing use of renewable resources as starting materials for surfactants is introduced, followed by extensive discussion of the major classes of bio-derived hydrophobes and hydrophiles. Also discussed is the status of research and development with regard to biosynthetically produced surfactants. Finally, concluding remarks address the potential for new surfactant molecular structures as a result of ongoing development in the chemistry of biorefineries, *i.e.*, that the transformation of lignocellulose into fuels is likely to support the manufacturing of new bio-based coproducts.

Convergence of trophic interaction strengths in grassland food webs through metabolic scaling of herbivore biomass

Authors: Oswald J. Schmitz and Jessica R. Price

Published: Journal of Animal Ecology 2011, 80, 1330–1336

Abstract: Food web theory hypothesizes that trophic interaction strengths of consumers should vary with consumer metabolic body mass ($mass^{0.75}$) rather than simply with consumer body mass ($mass^1$) owing to constraints on consumption imposed by metabolic demand for and metabolic capacity to process nutrients and energy. Accordingly, species with similar metabolic body masses should have similar trophic interaction strengths. We experimentally tested this hypothesis by assembling food webs comprised of species of arthropod predators, small sap-feeding and large leaf-chewing insect herbivores and herbaceous plants in a New England, USA meadow grassland. The experiment comprised of a density-matching treatment where herbivore species were stocked into field mesocosms at equal densities to quantify baseline species identity and metabolic body mass effects. The experiment also comprised of a metabolic biomass-matching treatment where smaller sap-feeding herbivore (SH) species were stocked into mesocosms such that the product of their density and metabolic body mass (metabolic biomass) was equal to the large herbivore (LH) species. We compared the magnitude of the direct effects of herbivore species on plants in the different treatments. We also compared the magnitude of indirect effects between predators and plants mediated by herbivores in the different treatments. Consistent with the hypothesis, we found that increasing metabolic biomass translated into a 9–14-fold increase in magnitude of herbivore direct effects and up to a fivefold increase in indirect effects on plants. Moreover, metabolic biomass matching caused interaction strengths among herbivore species to converge. This result came about through increases in the herbivore mean effects as well as decreases in variation in effects among treatment replicates as herbivore metabolic biomass increased. We found, however, that herbivore feeding mode rather than herbivore metabolic biomass explained differences in the sign of indirect effects in the different food webs. We conclude that increasing herbivore metabolic biomass not only strengthened the direct and indirect effects on plants but also made those effects more consistent across space. Nevertheless, metabolic biomass alone could not completely explain variation in the nature of indirect effects in the food web, suggesting that additional consideration of consumer traits like feeding mode will provide a more nuanced understanding of trophic interaction strengths in food webs.

Assessing Collective Firm Behavior: Comparing Industrial Symbiosis with Possible Alternatives for Individual Companies in Oahu, Hawaii

Authors: Chertow, M., Y. Miyata

Published: Business Strategy and the Environment, 20(4), 266–280, 2011.

Abstract: Are companies better off acting collectively in sharing resources, such that one company's waste becomes another company's feedstock, or is it strategically preferable to act individually to minimize resource flows? Eleven enterprises on Oahu, HI, were found to be exchanging nine different materials, constituting previously undocumented industrial symbiosis collaboration, anchored by a coal-fired power plant in the Campbell Industrial Park. The environmental and economic performance of eight companies exchanging six of these materials is assessed based on price and quantity data collected during interviews with the participants. The largest environmental benefits were found to be reduced landfilling and conservation of primary materials, including 40 million gallons of fresh water and approximately 17 800 tons of coal annually. The research finds that symbiotic solutions, when made visible, are often preferable, especially on an island. Indeed, company managers who fail to consider symbiotic solutions for resource issues risk overlooking the most effective strategic options.

Vulnerability to temperature-related mortality in Seoul, Korea

Authors: Ji-Young Son, Jong-Tae Lee, G. Brooke Anderson, and Michelle L. Bell

Published: 2011, Environmental Research Letters 6 034027 doi:10.1088/1748-9326/6/3/034027.

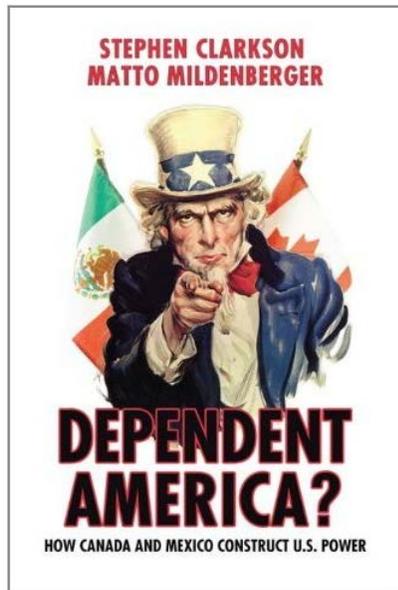
Abstract: Studies indicate that the mortality effects of temperature may vary by population and region, although little is known about the vulnerability of subgroups to these risks in Korea. This study examined the relationship between temperature and cause-specific mortality for Seoul, Korea, for the period 2000–7, including whether some subgroups are particularly vulnerable with respect to sex, age, education and place of death. The authors applied time-series models allowing nonlinear relationships for heat- and cold-related mortality, and generated exposure–response curves. Both high and low ambient temperatures were associated with increased risk for daily mortality. Mortality risk was 10.2% (95% confidence interval 7.43, 13.0%) higher at the 90th percentile of daily mean temperatures (25 °C) compared to the 50th percentile (15 °C). Mortality risk was 12.2% (3.69, 21.3%) comparing the 10th (–1 °C) and 50th percentiles of temperature. Cardiovascular deaths showed a higher risk to cold, whereas respiratory deaths showed a higher risk to heat effect, although the differences were not statistically significant. Susceptible populations were identified such as females, the elderly, those with no education, and deaths occurring outside of a hospital for heat- and cold-related total mortality. Our findings provide supportive evidence of a temperature–mortality relationship in Korea and indicate that some subpopulations are particularly vulnerable.

Disease, Population Viability, and Recovery of Endangered Sierra Nevada Bighorn Sheep

Authors: Maya L. Cahn, Mary M. Conner, Oswald J. Schmitz, Thomas R. Stephenson, John D. Wehausen, Heather E. Johnson

Published: 2011, The Journal of Wildlife Management 75(8):1753–1766; DOI: 10.1002/jwmg.232

Abstract Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*) experienced a severe population decline after European settlement from which they have never recovered; this subspecies was listed as endangered under the United States Endangered Species Act (ESA) in 1999. Recovery of a listed species is accomplished via federally mandated recovery plans with specific population goals. Our main objective was to evaluate the potential impact of disease on the probability of meeting specific population size and persistence goals, as outlined in the Sierra Nevada bighorn sheep recovery plan. We also sought to heuristically evaluate the efficacy of management strategies aimed at reducing disease risk to or impact on modeled bighorn populations. To do this, we constructed a stochastic population projection model incorporating disease dynamics for 3 populations (Langley, Mono, Wheeler) based on data collected from 1980 to 2007. We modeled the dynamics of female bighorns in 4 age classes (lamb, yearling, adult, senescent) under 2 disease scenarios: 5% lower survival across the latter 3 age classes and persistent 65% lower lamb survival (i.e., mild) or 65% reduced survival across all age classes followed by persistent 65% lower lamb survival (i.e., severe). We simulated management strategies designed to mitigate disease risk: reducing the probability of a disease outbreak (to represent a strategy like domestic sheep grazing management) and reducing mortality rate (to represent a strategy that improved survival in the face of introduced disease). Results from our projection model indicated that management strategies need to be population specific. The population with the highest growth rate (Langley; $\lambda \approx 1.13$) was more robust to the effects of disease. By contrast, the population with the lowest growth rate (Mono; $\lambda \approx 1.00$) would require management intervention beyond disease management alone, and the population with a moderate growth rate (Wheeler; $\lambda \approx 1.07$) would require management sufficient to prevent severe disease outbreaks. Because severe outbreaks increased adult mortality, disease can directly reduce the probability of meeting recovery plan goals. Although mild disease outbreaks had minimal direct effects on the populations, they reduced recruitment and the number of individuals available for translocation to other populations, which can indirectly reduce the probability of meeting overall, range-wide minimum population size goals. Based on simulation results, we recommend reducing the probability of outbreak by continuing efforts to manage high-risk (i.e., spatially close) allotments through restricted grazing regimes and stray management to ensure recovery for Wheeler and Mono. Managing bighorn and domestic sheep for geographic separation until Sierra Nevada bighorn sheep achieve recovery objectives would enhance the likelihood of population recovery.



Book Publications

Dependent America? How Canada and Mexico Construct US Power.

Authors: Stephen Clarkson and **Matto Mildemberger**

Published: 2011, University of Toronto Press, Scholarly Publishing Division

Abstract: This provocative work documents how Canada and Mexico offer the United States open markets for its investments and exports, massive flows of skilled and unskilled labor, and vast resource inputs— all of which boost its size and competitiveness — more than does any other US partner. They are also Uncle Sam's most important allies in supporting its anti-terrorist and anti-narcotics security. Clarkson and Mildemberger explain the paradox of these two countries' simultaneous importance and powerlessness by showing how the US government has systematically neutralized their potential influence.

Grant Awards

Sustainable Cities - People, Infrastructures and the Energy-Climate-Water Nexus

Sponsor: National Science Foundation

PI: Anu Ramaswami (Univ of Colorado-Denver), **Co-PIs :** **Marian Chertow, (Yale)**, Larry Baker (U of Minnesota), Larry Bank (City College New York), and Paty Romero-Lankao (National Center for Atmospheric Research)

Total Amount: \$750,000

Abstract: This NSF Research Collaboration Network (RCN) grant will assemble researchers from 20+ US Universities who will coordinate work on the overarching thematic topic of Sustainable Cities, with focus on reducing energy use, carbon emissions, and mitigating climate-risks to water supply and public health in cities. The RCN seeks to develop harmonized methods, open datasets, and shared curriculum on the topic of sustainable cities with a broad-based inter-disciplinary integration toward this goal. This new network will be managed via UC Denver's Center for Sustainable Infrastructure Systems (CSIS). Prof. Chertow's role is involved with quantifying infrastructure and cross-infrastructure interventions.

Research Spotlight

Congratulations to Jennie Miller, the Conservation Endowment Award recipient!



Jennie Miller was recently awarded a Conservation Endowment Award from the Association for Zoos and Aquariums and a Junior Fellowship from the American Institute for Indian Studies. These awards will support her dissertation research on tiger and leopard depredation on livestock in Kanha Tiger Reserve, India.

Jennie Miller is a Ph.D. Candidate at the Yale School of Forestry and Environmental Studies and a Research Affiliate with the Wildlife Institute of India.

She holds a B.A. 2007, Claremont McKenna College in Organismal Biology.

