

Upcoming Events

FES Seminar Lecture Series: Char Miller: Why Does Environmental History Matter in a Time of Climate Change?

12:00-1:00, Wednesday, Feb 22. Burke Auditorium, Kroon Hall.



Char Miller is director of the environmental analysis program at Pomona College and the W. M. Keck Professor of Environmental Analysis. He received his Ph.D. from the Johns Hopkins University and B.A. from Pitzer College.

He is author of the award-winning *Deep in the Heart of San Antonio: Land and Life in South Texas*, *Gifford Pinchot and the Making of Modern Environmentalism*, and *Ground Work: Conservation in American Culture*. Most recently, he is editor of *Cities and Nature in the American West*, and the companion volumes, *Water in the 21st-Century West and River Basins of the American West*; forthcoming is his co-edited volume, *Between Ruin and Restoration: An Environmental History of Israel* (2012). Miller is a regular contributor of essays, commentary, and reviews to professional journals, newspapers, and online media. His talk at Yale is drawn in part from his *Public Lands, Public Debates: A Century of Controversy* (Oregon State University Press), which appear in April.

Cheick Diarra: What Rio+20 Can Do for the Most Vulnerable Countries

11:30-12:30, Thursday, Feb 23 in Burke Auditorium, Kroon Hall.

Mr. Cheick Diarra (UN Under-Secretary-General, Special Advisor on Africa, and High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States) will be giving this talk titled What Rio+20 Can Do for the Most Vulnerable Countries. All faculty, staff, and students are welcome. Refreshments will be provided.

The road to Rio+20 Conference and what can be achieved: Mexico's role and overview of the process

5:00- 6:00, Thursday, Feb 23 in Sage Hall, Bowers Auditorium

Mr. Jorge Laguna-Celis is the delegate for environment and sustainable development, representing the Permanent Mission of Mexico to the United Nations. Prior to this, he was working in Kenya with the Embassy of Mexico as Deputy Representative to UNEP and UN Habitat, and in the Foreign Ministry of Mexico with the Instituto de los Mexicanos en el Exterior and with the Mexican Diplomatic Academy (2005-2006). He obtained an MA in International Trade and Sustainable Development Policies from the Institut d'Etudes Politiques, Paris (2000-2002) and a BA in International Relations from El Colegio de México, Mexico City (1996-2000).

Journal Publications

Restoration of Ailing Wetlands

Authors: Oswald. J. Schmitz

Published: 2012, PLoS Biology, 10(1): e1001248. doi:10.1371/journal.pbio.1001248

Abstract: It is widely held that humankind's destructive tendencies when exploiting natural resources leads to irreparable harm to the environment. Yet, this thinking runs counter to evidence that many ecological systems damaged by severe natural environmental disturbances (e.g., hurricanes) can restore themselves via processes of natural recovery. The emerging field of restoration ecology is capitalizing on the natural restorative tendencies of ecological systems to build a science of repairing the harm inflicted by humans on natural environment. Evidence for this, for example, comes from a new meta-analysis of 124 studies that synthesizes recovery of impacted wetlands worldwide. While it may take up to two human generations to see full recovery, there is promise, given human will, to restore many damaged wetlands worldwide.

Road to evolution? Local adaptation to road adjacency in an amphibian (*Ambystoma maculatum*)

Authors: Steven P. Brady

Published: 2012, *Scientific Reports*, 2(235) doi:10.1038/srep00235

Abstract: The network of roads on the landscape is vast, and contributes a suite of negative ecological effects on adjacent habitats, ranging from fragmentation to contamination by runoff. In addition to the immediate consequences faced by biota living in roaded landscapes, road effects may further function as novel agents of selection, setting the stage for contemporary evolutionary changes in local populations. Though the ecological consequences of roads are well described, evolutionary outcomes remain largely unevaluated. To address these potential responses in tandem, I conducted a reciprocal transplant experiment on early life history stages of a pool-breeding salamander. My data show that despite a strong, negative effect of roadside pools on salamander performance, populations adjacent to roads are locally adapted. This suggests that the response of species to human-altered environments varies across local populations, and that adaptive processes may mediate this response.

The impact of climate change on global tropical cyclone damage

Authors: Robert Mendelsohn, Kerry Emanuel, Shun Chonabayashi & Laura Bakkensen

Published: 2012, *Nature Climate Change*, doi:10.1038/nclimate1357

Abstract: One potential impact from greenhouse-gas emissions is increasing damage from extreme events. Here, we quantify how climate change may affect tropical cyclone damage. We find that future increases in income are likely to double tropical cyclone damage even without climate change. Climate change is predicted to increase the frequency of high-intensity storms in selected ocean basins depending on the climate model. Climate change doubles economic damage, but the result depends on the parameters of the damage function. Almost all of the tropical cyclone damage from climate change tends to be concentrated in North America, East Asia and the Caribbean–Central American region. This paper provides a framework to combine atmospheric science and economics, but some effects are not yet modeled, including sea-level rise and adaptation.

Information Seeking About Global Climate Change Among Adolescents: The Role of Risk Perceptions, Efficacy Beliefs, and Parental Influences

Authors: Erin Mead, Connie Roser-Renouf, Rajiv N. Rimal, June A. Flora, Edward W. Maibach & Anthony Leiserowitz

Published: 2012, *Atlantic Journal of Communication*, 20:1, 31-52

Abstract: Global climate change is likely to have significant impacts on public health. Effective communication is critical to informing public decision making and behavior to mitigate climate change. An effective method of audience segmentation, the risk perception attitude (RPA) framework, has been previously tested with other health behaviors and classifies people into 4 groups on the basis of their perceptions of risk and beliefs about personal efficacy. The 4 groups—indifference (low risk, weak efficacy), proactive (low risk, strong efficacy), avoidance (high risk, weak efficacy), and responsive (high risk, strong efficacy)—are hypothesized to differ in their self-protective behaviors and in their motivations to seek information. In this article, we extend the RPA framework in two ways. First, we use it at the household level to determine whether parental classifications into the 4 groups are associated with their teenage children's classification into the same 4 groups. Second, we predict adolescent information seeking behaviors on the basis of their and their parents' membership in the 4 RPA groups. Results ($N = 523$ parent–adolescent pairs) indicated that parental membership in the 4 RPA groups was significantly associated with children's membership in the same 4 groups. Furthermore, the RPA framework was a significant predictor of adolescent information seeking: Those in the responsive and avoidance groups sought more information on climate change than the indifference group. Family communication on global warming was positively associated with adolescents' information seeking. Implications for interventions are discussed.

Book and Book Chapter Publications

Book: **Managing Forest Carbon in a Changing Climate**

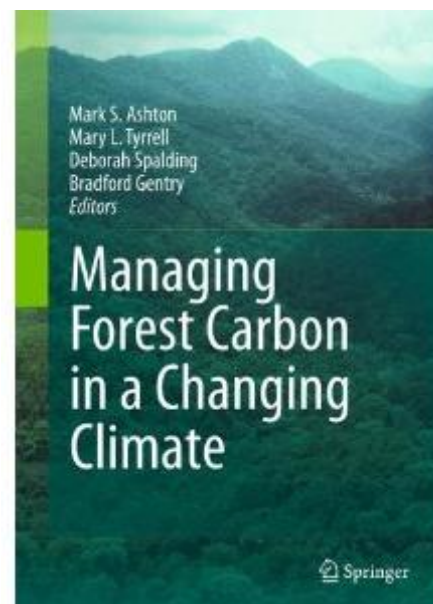
Author: Ashton, M.S.; Tyrrell, M.L.; Spalding, D.; Gentry, B. (Eds.)

Published: 2012, Springer, ISBN 978-94-007-2231-6

- **A comprehensive review of current thinking with recommendations for research**
- **A set of guidelines and recommendations for forest carbon management and policy**
- **A unique synthesis of forest carbon science, management and policy of what we know and what we do not know.**

The goal of this volume is to provide guidance for advanced students, land managers and policymakers seeking to understand the complex science and policy of forest carbon as it relates to tangible problems of forest management and the more abstract problems of addressing drivers of deforestation and negotiating policy frameworks for reducing emissions from forests. It is an attempt at a comprehensive state-of-the-art review, encompassing the science of carbon sequestration in forests, management of forests for carbon and other values, and the socio-economic and policy implications and challenges of managing forests for carbon.

Forests are critical to mitigating the effects of global climate change because they are large storehouses of carbon and have the ability to continually absorb carbon dioxide from the atmosphere. But today, *emissions* from land use, land use change, and forestry, mostly due to deforestation in the tropics, are estimated at 17% of total annual global CO₂ emissions, a figure larger than the transportation sector. While the basic principles of the carbon cycle are well known, there are significant uncertainties about the actual behavior of many of its sinks and sources. Much work has been done on the science of forest carbon, deforestation, and various climate policy responses, however, what is lacking is a comprehensive review of all aspects of the challenge. This book provides such a review by taking a holistic perspective on the subject. By creating a publication that outlines the research that has been done on forest carbon, pointing out what we know and what we don't know, and the implications for policy decisions.



Research Spotlight

Understanding the rebound effect: How much more do consumers drive when we implement fuel economy standards?

In 1865, the English economist William Stanley Jevons observed that technological improvements that made coal engines more efficient led to the increased consumption of coal in a wide range of industries. He argued that, contrary to intuition, efficiency improvements could not be relied upon to reduce fuel consumption. In his argument that became widely known as the Jevons Paradox, he wrote,

"It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth."

In other words, increased efficiency may be ineffective in reducing the consumption of fuel, and might in fact increase it. The "take-back" (or rebound) effect is an economic argument: if prices are lowered or efficiency increases, people will "take back" the savings by consuming more fuel.



Ken Gillingham asks: do people drive more when their cars are more efficient? In order to understand this, he looks at the way drivers respond to gasoline prices drop. This relationship is known as the direct rebound effect: if it's cheaper to drive a mile, people can be expected to drive more. "Consumers are responsive to gasoline prices in both vehicle choice and driving decisions," he finds, "with a medium-run (roughly two years) gasoline price elasticity driving for personal vehicles around -0.15. These responses vary by income, geographic, and demographic groups."

Another question arises: What if they spend money saved on fuel on other things, which are also energy- and carbon-intensive? This is the indirect rebound effect: the less is spent on energy, the more will be spent on consumer goods. Statistically, however, people spend more of their income on services than on goods, and services are much less carbon-intensive. While we don't know how the marginal dollar is spent, Gillingham explains, on average Americans spend more on more services, which in general are less energy-using and carbon emitting than goods. This implies the indirect rebound effect

should be small.

Cultural values, other externalities, and confounded effects of consumer preferences make it difficult to tease out the take-back effect, but Gillingham estimates the direct rebound effect is likely to be dominant at ~20%, while the indirect rebound effect is likely to be less than 10%--much to the chagrin of William Stanley Jevons, who thought the rebound effect will exceed savings.

There is a third effect, known as the general equilibrium rebound effect: at the scale of entire economies, when developed countries become more efficient, demand for energy will drop, leading to lower prices around the world. Other countries, including poorer countries, may then be inclined to use more energy. Gillingham estimates that the general equilibrium rebound effect is likely to be small, and not necessarily bad. Affording energy at lower prices can help poor countries gain access to mobility and other essential services, which is socially desirable even if it uses a little more energy.



Photo credit: cdn.benzinga.com

Grant Awards

Collaborative Research: Is the export of ancient, labile carbon from glacial ecosystems driven by the deposition of fossil fuel combustion byproducts?

Sponsor: National Science Foundation

Collaborators: Aron Stubbins (Skidaway Institute of Oceanography), Marc Frischer (Skidaway Institute of Oceanography), **Peter Raymond (Yale F&ES)**, Robert Spencer (Woods Hole), Eran Hood (Univ of Alaska-Juneau)

Amount of Yale Award: \$133,983

Project Description: Glaciers and ice sheets represent the second largest reservoir of water in the global hydrologic system and glacial ecosystems cover 10 % of the earth. Yet the carbon dynamics underpinning these ecosystems remain poorly understood. Improving knowledge of glacial biogeochemistry is particularly important as they are among the environments most sensitive to climate warming and industrial forcing. Most notably, glacial wastage is accelerating due to rising temperatures, changing precipitation patterns and the deposition of black carbon, which darkens glacial surfaces enhancing their absorption of light and heat.

Preliminary research suggests that the flux of labile, ancient carbon from Gulf of Alaska glaciers to the Pacific Ocean is a modern phenomenon, attributable to the deposition of fossil fuel derived aerosols. We hypothesize that the deposition of fossil fuel combustion derived organic matter (OM) is a universal phenomenon, but generally lost against the background of much greater net processes occurring in situ. In frigid glacial environments atmospheric OM inputs stand out, making glaciers ideal sentinel ecosystems for the detection and study of anthropogenic perturbation of global ecosystems through deposition. We further hypothesize that deposition is the primary source of fixed carbon to glacial ecosystems along the Gulf of Alaska. The proposed work will determine the contribution to the glacial OM pool made by fossil fuel derived aerosols, verify whether this organic matter is indeed ancient and labile, and quantify the extent to which it is being exported to downstream ecosystems.

Comprehensive Multilevel Cycle of Zinc

Sponsor: The International Zinc Association

PI: Thomas Graedel

Co-PI: Barbara Reck

Total Amount: \$126,101

Project Description: With support from the U.S. National Science Foundation, the Nickel Institute, the International Stainless Steel Forum (ISSF), and other sources, the Yale University Stocks and Flows (STAF) Project has been characterizing the human-related life cycles, trade, and stocks of nickel, stainless steel, and other metals over various spatial levels and time periods. This document proposes to expand upon existing work on zinc from the mid-90s, updating data and methodology to today's available knowledge. The study will result in zinc cycles for the year 2010 for more than 50 countries, eight world regions, and the world. Based on the global zinc cycle in 2010 zinc sustainability indicators such as the End-of-Life Recycling Rate and Recycled Content will be calculated. These timely indicators will be useful tools for discussions with the public and policymakers alike.

Assessment of Metal Criticality

Sponsor: Volkswagen, Grundfos ("Criticality Consortium")

PI: Thomas Graedel

Total Amount: \$100,000

Project Description: There are many scarce elements, and most of them have important uses in modern technology for which suitable substitute materials do not exist. Although their scarcity is well known, the key issue is whether that scarcity implies long-term shortages or unavailability. To address this issue, a detailed methodology for generating a reliable assessment of the criticality of metals has been completed. The methodology makes extensive use of peer-reviewed datasets and analytical approaches from the fields of geology, international trade, political science, and international policy, among others. In the research proposed herein, we will use this methodology to evaluate the company, country-level and global criticality of a number of metals, selected in collaboration with sponsoring collaborators from industry and/or government (the "criticality consortium"). On an individual basis, we will work with those collaborators to assess metal criticality for their particular interest. We will also generate for these metals scenarios of possible trajectories over time in a "criticality space". The results will provide guidance for product development, recycling potential, and the design of substitutes for the materials that we analyze.

Comprehensive Multilevel Cycle of Stainless Steel in 2010

Sponsor: The International Stainless Steel Forum

PI: Thomas Graedel

Co-PI: Barbara Reck

Total Amount: \$84,986

Project Description: With support from the U.S. National Science Foundation, the Nickel Institute, the International Stainless Steel Forum (ISSF), and other sources, the Yale University Stocks and Flows (STAF) Project has been characterizing the human-related life cycles, trade, and stocks of stainless steel, iron, chrome, nickel, and other metals over various spatial levels and time periods. As part of this work, we have developed data structures, formats, and detailed information libraries pertinent to characterizing the materials widely used in the modern technological society, including methodologies related to international trade, discard, and recycling. The recent study on the stainless steel life cycles in 2000 and 2005 provided valuable insights into the stainless steel life cycle as a whole, and into the changes that took place within the first 5 years of the 21st century, a period dominated by China becoming a major player in the metal industry. We propose to (i) continue this work by performing a 2010 cycle that will allow us to see how China's rapid growth continued to transform the stainless steel industry, and also to understand how the global financial crisis in 2008/09 has impacted different countries at different stages of the stainless steel life cycle. We also propose to (ii) estimate and analyze the historic use of stainless steel in different world regions, and to derive estimates on the current in-use stocks of stainless steel at the country level. Knowledge on these stainless steel stocks will help understand the future old scrap supply: how much will arise, in which countries or regions will we see most old scrap, and in which form (e.g., machinery, construction) is it likely to be collected. Finally, we propose to (iii) describe the share of molybdenum-containing stainless steel grades in the production and use of stainless steel, and at its end-of-life. We will also make some rough estimates on molybdenum's recycling rates, including non-stainless steel applications.

Nickel's Past and Future: Learning from History to Develop Meaningful Supply and Demand Scenarios

Sponsor: Nickel Institute

PI: Thomas Graedel

Co-PI: Barbara Reck

Total Amount: \$199,065

Project Description: With support from the U.S. National Science Foundation, the Nickel Institute, ISSF, and other sources, the Yale University Stocks and Flows (STAF) Project has been characterizing the human-related life cycles, trade, and stocks of nickel and other metals over various spatial levels and time periods. As part of this work, we have developed data structures, formats, and detailed information libraries pertinent to characterizing the materials widely used in the modern technological society, including methodologies related to international trade, discard, and recycling. This research assumes added value when used to (i) investigate the historic use of nickel as a basis for estimating current nickel in-use stocks, and (ii) develop scenarios of possible futures for nickel supply and demand. We therefore propose to construct, run, and analyze what we believe to be the first comprehensive scenario analysis on a global scale for any of the industrial metals. This effort will be built on a framework developed by UNEP's Resource Panel, but with a particular focus on nickel. In particular, we will accomplish the following: (1) estimate the historic nickel flow into use at a spatially disaggregated level (regions or countries), including estimates on the historic end-use sector split per region/country, (2) estimate the current nickel in-use stocks for the six main end-use sectors and 52 countries, (3) develop a set of preliminary scenarios for the period 2010-2030, (4) convene two workshops to present, discuss, and improve the scenarios, (5) using the recently completed nickel cycles as a basis, compute the nickel demand required to satisfy the conditions of each of the scenarios over the 2010-2030 time period, (6) from considerations of primary and secondary resources, compute the anticipated potential of nickel supply to meet the demands implied by each of the scenarios, and (7) comment on the implications of the results for the nickel industry.