

iowatch

Fall 2009

LEGACY



For the past three years, **Burns Weston** has been writing and lecturing about the kind of environmental future we are bequeathing to future generations. He is concerned about our collective “climate legacy”: the future challenges that will spin off of our actions today, the environmental problems that we are unwittingly leaving behind, problems that tomorrow’s people will not have requested and do not want. In this way, Weston has served as CGRER’s moral compass.

Weston’s efforts have been channeled into the Climate Legacy Initiative, a collaborative project of Vermont Law School and the University of Iowa’s (UI’s) Center for Human Rights. This project, which addresses our moral and legal environmental obligations to coming generations, has been directed by Weston. The project’s newly published policy



paper, *Recalibrating the Law of Humans with the Laws of Nature: Climate Change, Human Rights, and Intergenerational Justice*¹, was co-authored by Weston and Tracy Bach (of Vermont Law School) in collaboration with CGRER members **Jonathan Carlson** and **Jerry Schnoor** (among others), each of whom also authored background papers for this major report.

Weston’s dedication encourages all of us to consider our own environmental legacy. What exactly will each of us be leaving for those yet to be born? Are we creating conditions that

will bless or curse Earth’s future citizens? Contemplating our legacy is a way of pushing our mental envelope outward: of extending our thoughts beyond the daily here-and-now to encompass future times and far-reaching places. And it’s a way of encouraging forward-looking, proactive responses to environmental challenges – rather than reacting to burgeoning problems after the fact. With this model in mind, we might ask how well CGRER members have heard the message: How are their teaching and research positively shaping tomorrow’s world?

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Let's begin with energy. It's a big topic in Iowa, one that commonly focuses on short-term economic benefits as well as long-term climate effects. Numerous discussions have pondered the environmental costs of biofuels, in particular the high water demands, far-reaching water pollution, and soil erosion resulting from intensive corn-biofuel production. Might there be a better future for Iowa, one that ties alternative energy systems to positive environmental as well as economic payoffs?

UI President Sally Mason focused on this subject during the past year, when she co-chaired a Task Force on National Energy Policy and Midwestern Regional Competitiveness that was convened by the Chicago Council on Global Affairs. The resulting report, *Embracing the Future: The Midwest and a New National Energy Policy*², released in June 2009, concluded that the Midwest (which consumes proportionally more carbon-based fuels than the national average) must indeed turn the challenge of changing energy and climate policy into an economic advantage, if it is to maintain its prosperity and competitiveness. The report emphasizes that moving toward a post-carbon economy could

lead to future growth and jobs in the Midwest. This initiative helped spark the CGRER-funded symposium *Energy and Climate Change in the Midwest: Creating Opportunities in the New Economy*, held in October 2009 and presented through the UI's Forkenbrock Series on Public Policy, which examined these intertwinings of renewable energy alternatives, new economic opportunities, and environmental concerns.

In the meantime, the Iowa Climate Change Advisory Council, chaired by **Jerry Schnoor**, released its final report in December 2008³. That report outlined strategies for dramatically reducing Iowa's greenhouse gas emissions by developing new technologies and fuels and by furthering energy efficiency. Many of the strategies created win-win solutions that cut costs and greenhouse gases, even as they created new jobs and stimulated Iowa's economy.

Schnoor, along with **Gene Takle**, **Peter Thorne**, **Laura Jackson**, and advisory board member **David Osterberg**, are now members of a state committee (newly organized through the Iowa Office of Energy Independence) that

in January 2011 will report on the specific effects of climate change on Iowa's agriculture, public health, flora and fauna, and the like.

Energy futures and concerns also continue to be explored through CGRER's former graduate research assistants such as **Elliott Campbell** (UI PhD, 2007), whose most recent paper in *Science*⁴ compares the efficiency of various types of biomass conversion (e.g. conversion into electricity or ethanol) with the goals of maximizing the transportation benefits and minimizing the greenhouse gas production of biofuel-derived energy.

Energy production is getting a lot of attention in part because of its close association

with greenhouse gases, and in part because it is so central to our lives. Drastically reducing per-capita energy use without making other adjustments could alter our lifestyles dramatically. However, amenities other than energy are even more basic to human life. Consider water and air, for example. These prerequisites to life are, at the most elementary level, gifts of a healthy natural world. Water is purified and safeguarded when it enters raw earth, and we all rely on green plants and the photosynthetic process for cleansing air and providing ample oxygen.


CGRER's influence is felt at this very basic life-support level as well, through the work of numerous members. At the



Copenhagen Express

CGRER is funding two college- or graduate school-level students to attend the United Nations Climate Change Conference in Copenhagen in December. Student attendees will be admitted as observers of the conference, which means they watch first-hand the formal negotiations that may lead

to a new global climate treaty to replace the Kyoto Protocol. Iowa's student attendees will be selected on the basis of previous experience and essays, and will be required to make outreach presentations to their communities upon their return. This activity is being organized through the Iowa United Nations Association, which hopes to fund a total of ten student observers in Copenhagen.



Watershed Year

CGRER and its sister institute IHR-Hydrosience & Engineering have funded a book on the science of Iowa's 2008 floods. The 25-chapter *A Watershed Year: Anatomy of the Iowa Floods of 2008*, edited by Cornelia F. Mutel, contains eight chapters with CGRER-member authors. The book is intended to explain flood behavior, causation, and mitigation to lay readers and experts alike, with the goal of improving diverse long-term efforts to lessen flood intensity. The book's message is clear: we still have much to do, both in deciphering the mechanisms of these extreme natural events and in reshaping human responses to their continuing threat. *A Watershed Year* is being published by the University of Iowa Press and will be available by March 2010 from www.uiowapress.org or from bookstores.



most pragmatic level, **Lou Licht** and his firm Ecolotree, Inc., are designing a phyto-remediation system (one that uses plants to cleanse water) for Whidbey Island, Washington, which will treat 200 million gallons annually of combined municipal stormwater and wastewater, along with agricultural drainage water that currently threatens the local Puget Sound water quality and shellfish industry. His phyto-remediation techniques are now being applied across the country to treat landfill leachate. **Nandita Basu** also considers waterborne contaminant transport through Earth's subsurface (see page 7). Her research reflects the legacy of historic land uses on concentrations of groundwater and stream contaminants, as well as the potential contributions of newly introduced contaminants to water pollution in coming decades.

Brian Hornbuckle, **Witek Krajewski**, and **Bill Eichinger** (with others) are helping to develop mechanisms for

monitoring Earth's water flow via satellite. They are working toward this end by developing the Iowa Validation Site, a field site with a variety of instruments that will make detailed ground-based soil-moisture measurements in order to confirm parallel satellite measurements. Although now in its infancy, a satellite-based hydrology-monitoring system could ultimately feed information into forecasting food and biofuel production and climate (including climate change and floods). This ISU-based field site operates parallel to the UI's Clear Creek Hydrological Observatory, a watershed where instruments are monitoring multiple aspects of water's flow. CGRER's **Thanos Papanicolaou**, **Marian Muste**, **Craig Just**, **Jerry Schnoor**, and post-doc **Chris Wilson** are involved in Clear Creek.

Earth's excesses are being considered by **Witek Krajewski** and several other CGRER members. Krajewski, whose long-term research is dedicated

to improving remote sensing and forecasting of rainfall and rainfall results, such as flooding, is the director of the new state-funded Iowa Flood Center. This center will work to improve Iowa's flood forecasting and warning systems through streamflow monitoring systems and numerical models of water's flow through watersheds.

CGRER members are also heavily involved in safeguarding our planet's air. **Charles Stanier**, for example, is evaluating air quality data for eastern Iowa. He is determining regions where air particulate levels may be non-compliant with EPA standards and considering how these pollutants could be most effectively controlled. In addition, he is continuously monitoring eastern Iowa's carbon dioxide and other greenhouse gases. **Bill Field** is serving as a consultant to the EPA regarding global warming's impact on indoor air quality, and he is co-author and editor for the World Health Organization's newly published *Handbook on*

*Indoor Radon – A Public Health Perspective*⁵.

Greg Carmichael's research team demonstrated in the 1990s that windblown dust and air pollutants could be transported from China across the Pacific Ocean and impact air quality in the western US. Today there is growing awareness of the worldwide circulation of air pollutants, but **Gene Takle's** research reminds us that we have much yet to learn. His coauthored paper "Wind Speed Trends over the Contiguous USA"⁶ reveals that surface wind speeds across the country have decreased, on average, a half of a percent annually between 1973 and 2004. Although such decreases may not represent trends at turbine height, the causes and explanations of the recent wind decrease and implications for the wind power industry have not yet been explored.

Each of these research efforts contributes to the understanding and maintenance of elementary components



of Earth's life-support systems: clean water, clean air. In this way, these projects help preserve nature's health and integrity and our planet's provisioning of "ecological goods and services": amenities that support living systems of all types, just as they have done since life first appeared on our planet. For the most part, humans take ecological goods and services for granted. But, as climate change makes all too obvious, we cannot necessarily do so any longer. The touch of the human hand on natural systems and processes has, in some cases, overwhelmed their time-honored balance and integrity. This concept is reflected in the increasing discussions of how we might foster ecological goods and services – for example, by establishing "ecological services projects" similar to those that are being established around the globe, China for example has committed US \$100 billion to forested watersheds and similar functional landscapes to control soil erosion and hold and purify water⁷. And the concept is reflected in discussions of how we can restore native plants, animals, processes, and natural communities that are uniquely

tied to place. At the core of these ecological restoration efforts is the goal of preserving native biodiversity – the abundance and complexity of ancient life systems. The current rapid shrinking of biodiversity is one of Earth's most significant and far-reaching environmental problems, and it is likely to be exacerbated by climate change.

Many CGRER members are addressing our globe's biodiversity and its preservation. **Diane Debinski** teaches field and conservation biology and works with plant, insect, and bird diversity in Iowa (where she focuses on restoration research), and in Montana and Wyoming (where she examines climate change responses). **Steve Hendrix** studies plant-animal interactions and their relationship to preserving biodiversity, looking in particular at bee pollinators and insect dispersal in Iowa's highly fragmented modern prairies. **Laura Jackson** teaches courses in ecology and environmental studies and works on the restoration of biological diversity in agricultural landscapes; she also leads a professional science master's program in ecosystem management. **Jan Thompson** considers



the maintenance of healthy ecosystems and biodiversity in urban landscapes and models the spread of invasive species that can dramatically decrease native biodiversity. **George Malanson** is looking at tree movement upward into alpine tundra and its association with global warming, soil variations, moisture, geomorphology, etc., and at the relationship between spreading forest pathogens and changing climate at treeline; both could decrease mountain biodiversity in the western US. And **Jim Raich** is studying the usefulness of native tree species for reforestation of former pasturelands in lowland Costa Rica, with respect to their potentials for carbon sequestration and restoration of biodiversity to impoverished sites.

John Nason studies the molecular basis of biodiversity, looking at conservation, plant-insect interactions, and propagation of diversity through genetic studies. **Marc Linderman** is working with remote sensing techniques, using them to help



him examine the interactions between human activities and natural communities, and native species. And **Diana Horton** uses her taxonomic skills to identify and define plant diversity, particularly that of mosses and liverworts, and documents the survival of these plants in Iowa's native remnants. At the most basic level, each of these researchers is attempting to preserve the ecological services of diverse native plants, animals, and processes. Each is working to ensure healthy ecological systems for coming generations.

Legacy. It's an idea that we may not think about often, but one that can't be considered too much. Every action today is pushing us toward a different environmental future. From the kind of food we eat, to the way we choose to play or travel, to the home we inhabit, we are nudging the world in a different direction, increasing or decreasing options for our children's grandchildren and for all other lifeforms. **Vicki Grassian** said it when talking



Essays on Global Warming

Dick Baker was one of 67 essayists published in an engaging new book, *Thoreau's Legacy, American Stories about Global Warming*, published this year by the Union of Concerned Scientists and Penguin Classics. His essay, which describes the legacy he and his wife are creating, is excerpted on the right. The book can be ordered at this website, which also includes more information on the book project: <http://www.ucsusa.org/americanstories/>



Excerpt from *One Acre at a Time* by Dick Baker

Living in Iowa, which has the most altered landscape of any state, I appreciate Aldo Leopold's statement about living in a world of wounds. All around us I see the effects of human use and neglect: endless [rowcrop] monocultures, intensive soil erosion and gullies, and stream pollution...Global warming will only magnify these problems.

Eight years ago I had the good fortune to move out into the country, to 125 acres of woods, overgrown savannas, ponds, and fields. It was then that I saw a chance to make a difference...My wife, Deb, and I decided that our best legacy would be to return the land to [its original vegetation] pattern, restoring where we could and starting from scratch where that was necessary. This strategy will produce stable plant communities and landscapes even in the face of global warming. [Dick goes on to describe his efforts to plant prairies, restore savannas, and control erosion.]

It is a constant struggle to keep a handful of nonnative invasive species from taking over... On the positive side, we are solving a number of problems, preserving our natural heritage, and preparing well for any future changes. The long walks I take every day convince me that I'm doing the right thing. Seeing the diversity and beauty of the prairies, savannas, and woodlands and of the birds, butterflies, dragonflies, frogs, and other wildlife gives us great joy. We have found most of the missing pieces of the mosaic, and paradise lost is becoming paradise regained.

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about the underlying reasons for her new Seed grant (page 6): "After thinking about the most recent Intergovernmental Panel on Climate Change report, I concluded that every chemist should be working on carbon dioxide, and finding ways to reduce its atmospheric concentration and environmental impact." The Iroquois nation has stated it through its mandate to reflect on the impact of all deliberations and decisions on the next seven generations.

Burns Weston will be repeating

it in November 2009, when he lectures on our climate legacy at the tenth anniversary celebration of the UI Center for Human Rights. That day, he will once again be serving as our moral compass. Thanks, Burns. And thanks to all who deliberate distant environmental goals that will shape the lives of those to come, even as they work in today's here and now. Keep talking. ❄

¹ http://www.vermontlaw.edu/Documents/CLI%20Policy%20Paper/CLI_Policy_Paper.pdf

² <http://www.thechicagocouncil.org/UserFiles/File/Task%20Force%20Reports/09%20Energy%20Task%20Force%20-%20Full%20Report.pdf>

³ <http://www.iaclimatechange.us/capag.cfm>

⁴ Campbell JE, DB Lobell, CB Field. 2009. "Greater transportation energy and GHG offsets from bioelectricity than ethanol." *Science* 324(5930): 1055-1057.

⁵ http://whqlibdoc.who.int/publications/2009/9789241547673_eng.pdf

⁶ Pryor, S. C., R. J. Barthelmie, D. T. Young, E. S. Takle, R. W. Arritt, D. Flory, W. J. Gutowski Jr., A. Nunes, and J. Roads. 2009. "Wind speed trends over the contiguous United States." *Journal of Geophysical Research* 114, D14105, doi:10.1029/2008JD011416.

⁷ Ellison, K. 2009. "Ecosystem services – out of the wilderness?" *Frontiers in Ecology and the Environment* 7(1): 60.

CGRER Website: A New Look

As of September 2009, CGRER's website was completely revised. Jeremie Moen and assistants redesigned web pages and added movies and interactive educational documents. The new website will appeal to kindergarten through highschool educators who are searching for global-change material, as well as research collaborators who are seeking data. Visit the new website at <http://www.cgrer.uiowa.edu>

seeds

In 2009, CGRER funded six new seed grants for the coming fiscal year, for a total of \$156,650.

Speleothem Evidence for the Influences of Enso and Solar Variability on the Holocene Australian Summer Monsoon

Rhawn Denniston (Cornell College, Dept of Geology), \$27,000

To understand human-induced climate change, we must first comprehend how natural factors have influenced climatic fluctuations. These factors include our sun's heat output and ENSO (the El Niño/Southern Oscillation – periodic changes of ocean surface temperatures in the tropical Pacific Ocean that are associated with droughts, floods, and other short-term intense weather events), both of which affect monsoon rains. This seed grant is funding the collection and analysis of stalagmites from the monsoonal areas of northern Australia, for the purposes of reconstructing changes in monsoon intensity over the past 25,000 years and elucidating the relative influence of solar output and ENSO on these monsoons. A better understanding of the details and causation of prehistoric monsoon activity should help climate modelers address how Australia's monsoon will respond to future greenhouse gas-driven warming.

A Context for Alpine Tundra Response to Climate Change

George P. Malanson (UI Dept of Geography) and Dan Fagre (USGS), with field studies by graduate student Jonathan Rose (UI Dept of Geography), \$24,902



Alpine tundra, the uppermost plant community in our western mountains, is likely to be greatly stressed by climate change and warming temperatures. To assess such change in coming years, Malanson and Fagre are studying current variability in alpine tundra communities through examining alpine tundra data sets collected throughout western North America that quantitatively describe these communities. This grant is funding a simple statistical description of data on variations in tundra, and field work that establishes how much variability is introduced by sampling methodology. Determining the existing variability of current tundra

plant communities will establish a much-needed baseline for assessing future species loss due to climate warming, a loss that could be ecologically devastating. The study also may be helpful in directing future ecological monitoring efforts.

Sustainability of Crop Yields and Wind Power in Iowa under Expansion of Wind Farms

Moti Segal (ISU Agronomy Dept) and Eugene S. Takle (ISU Geological and Atmospheric Sciences Dept and Agronomy), \$27,000

Wind turbines are being built in different landscapes across the country. In Iowa, they are going up mainly in corn and soybean fields. How do these croplands affect turbine performance, and correspondingly how might the turbines impact crop growth? Hypothetical interactions abound: turbines may change the timing of frosts, dew deposition, field temperatures, disease proliferation, and other factors affecting crop growth. And surface roughness of croplands may affect turbine efficiency. This will be the first study to examine such interactions, by modeling the surface flux of moisture and heat in cornfields with turbines. Intended results include deciphering the mechanisms whereby wind turbines could beneficially influence growth of different crops, even as agricultural lands promote the effective harnessing of wind power.



The Effects of Climate Change on Soil Organic Matter and Soil Quality

in Iowa Thanos Papanicolaou and Jerry Schnoor (both UI Dept Civil and Environmental Engineering and IIHR – Hydroscience & Engineering) and Lee Burras (ISU Dept of Agronomy), with collaborator Christopher Wilson, \$25,870

Climate, along with cropland management practices, affect soil erosion and the distribution and presence of organic matter in agricultural soils. Climate change may accelerate the loss of soil organic matter, which is integral to a soil's productivity and water-retaining capabilities. This grant will start to explore such potential accelerated loss by funding a detailed analysis

of the carbon content of certain croplands within the Clear Creek drainage basin near Iowa City, and by creating a local GIS map of soil carbon content. These data will be used to create and calibrate a numerical model addressing soil organic-matter loss, intended to be predictive of such destructive loss in different locations within the Midwest.

Ecological Physiology, Gene Flow, and Demography among Fiddler Crab Populations (genus Uca) Along the South Atlantic Coast of Brazil

Carl L. Thurman (UNI Dept of Biology), \$24,878



Changing climate and other environmental challenges will necessitate better management of marine ecosystems if extinction of many native marine species is to be minimized.

Fiddler crabs are important to the ecology of coastal marine ecosystems, but they live in shallow waters that may be badly degraded and, in coming years, intensely affected by changing climate. This seed grant will help fund a survey of nine species of fiddler crabs along Brazil's coast. A comparison of these crabs will enhance our understanding of the physiologic processes required for adaptation to a changing marine environment. It also will tell us about the crabs' diversity and gene flow (features shaped by ocean currents and tide), and help pinpoint certain coastal areas with high biodiversity as conservation targets.

Carbon Dioxide Adsorption and Conversion on Nanomaterials

Vicki H. Grassian (UI Depts of Chemistry and Chemical and Biochemical Engineering), \$27,000

Carbon dioxide and other greenhouse gasses are known contributors to global warming. Researchers are now seeking techniques for reducing their current atmospheric concentrations. This grant seeks to do so by developing oxide nanomaterials (extremely tiny human-fabricated particles) that could catalyze the conversion of atmospheric carbon dioxide to useful substances such as methanol, which could then be used as feedstock for other beneficial chemicals. Carbon dioxide is already known to adhere to nanomaterials; the major challenge is thus developing nanoparticles that will enhance the highly selective and effective conversion of the gas. If successful, the grant could initiate a major new research focus for the UI's Nanoscience and Nanotechnology Institute.

New CGRER Members



Nandita Basu came to Iowa City in January, 2009, as an assistant professor in civil and environmental engineering and research engineer at IIHR-Hydroscience & Engineering. She received an undergraduate degree in civil engineering

in India, master's degree in environmental engineering from IIT Kanpur (India), and doctorate in environmental engineering in 2006 from Purdue, and she had completed post-doctoral appointments at Purdue University and the University of Florida. Her research incorporates field and modeling studies to understand contaminant transport through ground- and surface-water flows. She is now focusing on the transport and fate of nitrates applied as rowcrop fertilizers, as well as phosphorus, livestock hormones, particulate carbon, and other agricultural chemicals. By elucidating emergent patterns of loads of these chemicals with scale, she hopes to develop predictive models of their transport, chemical transformation, and concentrations in streams and rivers. Basu joined CGRER because of her interest in global environmental issues and the need to understand environmental pollution across spatial and temporal scales.



Matt Hill completed his doctorate and came to the University of Iowa's anthropology department in 2007. Both his master's degree (University of Kansas) and his PhD (University of Arizona) were in anthropology. Hill's research focuses on the long-term interactions between

prehistoric human hunting activities and environmental change. More specifically, he studies how Native American cultures have hunted and used animals as food during the past 12,000 years, and the resulting feedback loops between animal populations and evolving human cultures and environments. Could hunting activities have contributed to the disappearance of large mammal species around 12,000 years ago, or were there other significant environmental contributions to these extinctions? His interest in human responses to changing environments led him to CGRER membership. Hill points out that an understanding of ancient responses to changing conditions may help us understand our species' responses to the modern environmental changes that are of interest to many CGRER members.

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IoWatch is published each fall. Comments, questions, and requests for additional copies should be directed to:

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The University of Iowa's Center for Global and Regional Environmental Research (CGRER) promotes interdisciplinary efforts that focus on the multiple aspects of global environmental change, including its regional effects on natural ecosystems, environments, and resources, and on human health, culture, and social systems. Center membership is composed of interested faculty members at any of Iowa's colleges and universities.

Center goals are promoted by encouraging interdisciplinary research and dialogue among individuals whose disciplines touch upon any of the multifaceted aspects of global change. More specifically, the Center awards seed grants, fosters interdisciplinary courses, provides state-of-the-art research facilities and equipment, and holds seminars and symposia. The Center encourages students to broaden their studies and research through considering the multi-disciplinary aspects of global and regional environmental problems. Through such activities, the Center attempts to assist Iowa's agencies, industries, and citizens as they prepare for accelerated environmental change that may accompany modern technologies.

Housed in the Iowa Advanced Technology Laboratory at the University of Iowa, the Center was established by the State Board of Regents in 1990 and received funding from a public utility trust fund, as mandated by the State of Iowa's Energy Efficiency Act.

