Ecology & Evolutionary Biology

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BROWN

Letter from the Chair

By Mark Bertness

Greetings from an extremely enlarged EEB. As should be obvious from recent newsletters, we are now officially bursting at the seams with an infusion of new faculty and energy. You can appreciate the point from this edition of the newsletter. Our articles are all about the new faculty! We can hardly get everyone's picture to fit in the faculty directory outside the Walter Hall office, to say nothing of finding a place for everyone to hang their hats. However, we do have several new or renovated labs that have come on line since the last newsletter.

We've officially celebrated their opening this semester by holding our now traditional Friday afternoon happy hours there. We now have 21 faculty and a growing population of graduate students (23) and postdocs (18).

We are in the process of introducing exciting new courses in marine conservation, computational biology, conservation medicine, evolution of infectious disease, conservation biology, climate change biology and microbial ecology. In fact, just this month the faculty devoted an afternoon retreat to a discussion of the curriculum, focusing on such issues as what we want our undergraduates to know when they graduate, how successfully our current curriculum is servicing that concern, and how/if new or reorganized courses might serve that purpose. Our growth since we last discussed the issue in depth provides the opportunity for options that earlier would have been infeasable. At any rate we will be able to offer much to compliment the schedules of our always stellar undergraduates. It is a very exciting time to be a nature bunny at Brown!

Congratulations to both Jon Witman for his recent promotion to Full Professor and to Carol Casper for becoming the grandmother we always knew she was.

And kudos to Shannon Silva and Adella Francis for completing degree programs last spring just after the newsletter appeared.

Here's to a great 2008.

New to EEB in 2007

Liana Burghardt: research assistant - Schmitt Lab
Regina Campbell-Malone: postdoc, Ph.D. MIT/WHOI- Swartz Lab
Joaquin Chaves: postdoc, Ph.D. University of Rhode Island - Porder Lab
Caroline Harper: graduate student from University of North Carolina, Wilmington -Brainerd Lab
Shelby Hayhoe: graduate student from Grinnell College - Porder Lab
Matt Heard: graduate student from University of Tennessee - Sax Lab
Christine Holdredge: research assistant – Bertness Lab
Jen Knies: postdoc, Ph.D. University of North Carolina - Weinreich Lab
Sarah-Megumi Naylor: research assistant - Tatar Lab
R. Matt Ogburn: graduate student from University of Missouri St. Louis - Edwards Lab
Trina Pappadia: Administrative Assistant - Walter Hall
Gregory Sawicki: postdoc, Ph.D., University of Michigan, Ann Arbor - Roberts Lab
Justin Schaefer: postdoc, Ph.D., University of California, Irvine - Brainerd Lab
Allyce Sullivan: lab manager - Brainerd and Swartz labs
Aaron Weinblatt: research assistant - Sax Lab

...and faculty who joined us this fall (see the index to your right)

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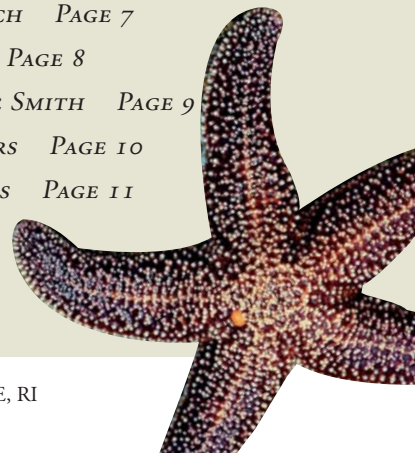


In the Greenhouse

By Fred Jackson

It's that time of year when experiments are starting to pop up in the greenhouses, and two interesting projects from Juliet Simpson and Joshua Blakeslee will prove to be very interesting.

Juliet Simpson (Post-doctoral Associate) and Kate Smith (EEB Assistant Professor) are working in the greenhouse to study water hyacinth (*Eichhornia crassipes*), an invasive aquatic weed with circumglobal distribution. Water hyacinth reproduces primarily by runners and forms dense mats that create an excellent habitat for mosquito larvae. An anecdotal report suggests that transmission of mosquito-borne diseases increases in areas with hyacinth invasions. The current research aims to define lines between the growth rate and latitudinal range extinction of water hyacinth in response to the increasing temperatures and nutrient availability expected with increasing urbanization and climate change, as well as its potential effects on emerging mosquito-vectored diseases such as West Nile Virus and Eastern Equine Encephalitis.

Post-doctoral associate Joshua Blakeslee (Alison Delong lab) will devote his research to rice. Rice, which yields $ 1.5 billion in export annually, is commonly grown in areas susceptible to flooding and salinity stress. He will focus on the role of a dephosphorylating enzyme in improving stress tolerance and agricultural yields. Progress made in rice could be transferred to other monocot crop species, including maize and sorghum.

Finally, Kaya Schmandt (utilizing many growth chambers) is doing her undergraduate thesis in the Schmitt lab. She is studying the effects of hydration/dehydration on the kinetics of seed germination in *Arabidopsis thaliana.* Kaya is also studying the interactions between temperature regimes and water cycles during germination, and the effects of this cycling on seed longevity and dormancy.

Additionally, she plans to investigate the natural variation in seed response to water shortage during germination by studying *Arabidopsis* accessions from a range of European climates. Kaya hypothesizes that European ecotypes from dry regions will be more tolerant of dehydration cycles during germination than ecotypes from wetter parts of Europe. This work fits in with the Schmitt lab's broader investigations into the natural variation of different ecotypes' responses to various climatic conditions across Europe.

Brown iGEM scoops gold at MIT synthetic biology competition

by John Cumbers

The Brown iGEM team scooped gold this year at the International Genetically Engineered Machine competition at MIT in early November. I was again a graduate mentor to the team of seven undergraduates who spent the summer in a basement lab of the Biomed Center. Although the team suffered a number of technical setbacks in putting their designs for synthetic biological systems into practice, they learned a lot in the short 10 week period.

Synthetic biology is a new field aimed at turning biology into a true engineering discipline by standardizing the way genes are used in combination and creating repositories of characterized parts that can be easily shared and re-used by others. This year the team was funded by a 25k donation from Pfizer and from various departmental contributions. Some creative videography and the use of viral marketing via the YouTube website also helped to attract sponsorship of equipment from Nanodrop and Labnet.

This is Brown's second year in the competition. Gary Wessel in MCB and I started a new course in synthetic biology this fall to help get next year's students (and ourselves) up to speed in the subject. Next semester we will present a practical lab course on the basic techniques that budding biological engineers need to know in order to turn their ideas into reality. This year the team continued work on a 3-way gene switch (Lohmueller et al 2007) and also came up with a new idea for an *E.coli* based lead sensor attached to a GFP reporter.

We've suffered from a lack of continuity, but we hope that both the theory course in the fall and the practical course in the spring will keep the lab active all year round, rather than just during the 10-week summer session. This should help to turn the great ideas into fully working systems. You can search for "brown igem" on youtube.com to see the award-winning videos.

News Update

Matt Ogburn was awarded a Sidney Frank Fellowship from the Division of Biology and Medicine.

Joaquin Chaves joined the Porder lab as a postdoc investigating the relationship between landscape evolution and forest fertility in Venezuela and Costa Rica.

Shelby Hayhoe joined the Porder lab as a Brown/MBL grad student (co-advised by Chris Neill). Shelby will be working on the ecosystem effects of large scale soy production in Brazil.

Dov Sax was an invited symposium speaker at theThe National Academy of Sciences Colloquium, "In Light of Evolution: Biodiversity and Extinction" (Sponsors: Francisco Ayala, John Avise and Stephen Hubbell), December 2007.

EEB alum **Jeffrey Townsend** was appointed to the Ecology and Evolutionary Biology Department at Yale University, after two years as Assistant Professor at the University of Connecticut.

Jon Witman was promoted to full professor in October. Congratulations, Jon!

Bonnie Horta has left us (kind of). She has moved over to assist Osvaldo Sala as administrative manager in the Environmental Change Initiative. The good part is that we often see Bonnie, since the ECI work so closely interdigitates with ours. **Trina Pappadia** is efficiently filling Bonnie's shoes, including responsibilities for this newsletter, although Bonnie has been a great help in getting Trina up to speed on the rather abstruse Indesign program we use. Thanks, Bonnie!

Marty Downs has also joined the ECI as Assistant Director, so with Osvalsdo, Marty, Bonnie, and the new faculty on board, the Institute is really moving into high gear.

ECI Explores Energy & Environment

By Marty Downs

"When an ecologist from Brown University invites an engineer from Iowa to speak, you know something different is going on," said Robert Brown in the third lecture of the Environmental Change Initiative's Energy and the Environment series this fall. Indeed, one goal of the lecture series was to stimulate further discussion and interaction between the sometimes very separate fields that focus on energy and climate change.

Lectures in the fall series included low-energy, low-cost technology for developing countries by Ashok Gadgil, an engineer at Lawrence Berkeley National Laboratory, who wooed an overflow crowd in MacMillan 115 with his account of an uncommonly common-sense approach to water purification in his native India. Reports of the devastating cholera outbreak there in the early 1990's inspired Gadgil's first foray into what became his award winning technology and he has gone on to launch hundreds of village-owned, operated, and maintained water purification systems. His current project is developing a hyper-efficient but inexpensive cook stove for Darfur refugees that simultaneously reduces ecological damage and violence against women, who are primarily responsible for making long, dangerous trips to gather fuel wood.

Ecologist David Tilman spoke second, combining plenty of hard data with a compelling story about the risks and possibilities for biofuel production. Where it displaces food crops, Tilman warned, the benefits are rarely worth the costs. And the carbon lost through deforestation may never be repaid by biofuel production on deforested land. However, by producing biofuel from high-diversity grasslands on otherwise marginal lands and returning the nutrient by-products to the soil, he showed there are environmentally sound ways to meet a portion of US energy demand with biofuels.

Robert Brown's talk focused on improving the efficiency of biofuel production, including the use of non-crop feedstocks, redesigning the production process, and reusing fuel-production byproducts as fertilizer. He contends that within ten years, one barrel of oil inputs will yield five to eight barrels of biofuel, a much more favorable ratio than the current return from corn ethanol, which is barely above one.

The seminar series continues in the spring semester:

March 20: Kenneth Cassman, Professor of Agronomy and Horticulture, University of Nebraska, Author of Biofuels, Food Security, and the Environment

April 22: Thomas Friedman, New York Times columnist

TBD: Daniel Kammen, Professor of Public Policy, University of California, Berkeley, Director of Renewable and Appropriate Energy Laboratory, co-Director, Berkeley Institute of the Environment

TBD: Nathan Lewis, Professor of Chemistry, California Institute of Technology , Scientific Challenges in Sustainable Energy Technology

If you are near Brown on any of these dates, you should try to attend one of these talks. The three presented thus far have been outstanding. (Ed.).

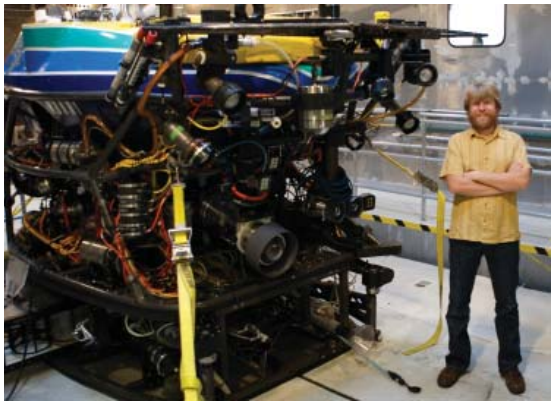
Casey Dunn,
Assistant Professor, EEB

I joined the faculty of EEB this summer following a two-year postdoc at the University of Hawaii. My lab investigates how evolution has produced a diversity of life through the origin and modification of developmental mechanisms. Since the structure of organisms arises via developmental processes, structural modifications of organisms are realized through evolutionary changes in developmental mechanisms. I use evolutionary developmental biology to learn about the actual history of life on Earth and properties of evolution that have contributed to these historical patterns.

My research draws on many types of tools and requires field, laboratory, and computational work in about equal proportion. I enjoy spanning very different approaches to and ways of thinking about core conceptual issues. This is a big part of what motivated me to become a biologist- it is very rewarding to describe the natural history of undescribed deep-sea organisms one week, delving into 19th century literature and wrestling with the same timeless issues biologists were wrestling with 150 years ago, and the next week be refining methods for creating transgenic sea anemones or writing software to analyze genomic datasets on a supercomputer. More than anything I like bringing new tools to very old questions, many of which may have been largely forgotten in the interim.

Most of developmental biology is concerned with the organization of functionally specialized cells in time and space, and most of evolutionary developmental biology is concerned with how changes in these developmental processes have led to a diversity of multicellular organisms. There are, however, other levels of biological organization where the exact same conceptual issues are at play, but that have remained largely unstudied. One of these is colony-level organization. Colonial animals are made up of asexually produced multicellular individuals, each of which is structurally and evolutionarily equivalent to solitary free-living animals such as ourselves. And just as there are developmental mechanisms that organize cells in multicellular individuals, there are developmental mechanisms that organize multicellular individuals in colonies. Understanding how these colony-level developmental mechanisms work and how they arose is directly relevant to understanding the origin and evolution of developmental mechanisms at all levels of biological organization.

I am particularly interested in the siphonophores, a group of colonial deep-sea superorganisms that include the longest animals in the world. Visit http://siphonophores.org, an educational site I maintain, to learn more about them. Siphonophores belong to Cnidaria, which also includes corals, jellyfish, and hydroids. Siphonophores are the most complex of all colonial organisms—there is a high degree of division of labor between individuals, and the individuals are precisely arranged in the colony. It is as if you had several thousand conjoined twins, some of which fed, some reproduced, some were responsible for circulation, and some performed still other tasks. I have described the developmental processes by which these functionally specialized individuals arise within the colony, and am now working to understand the mechanisms that regulate these processes.



Though siphonophores include the longest animals in the world and are among the most abundant macro-organisms in the open ocean, we know very little about them because they are extremely fragile and break apart in nets. I thus collect them using remotely operated underwater vehicles, or by SCUBA diving from ships in the open ocean. Because siphonophores are so poorly known I also work on other basic aspects of their biology, such as describing natural history and new species.

The development of phylogenetic tools and the application of these tools to particular groups of organisms are also central to my work. In collaboration with the Protostome Tree of Life Project I am investigating the relationships of the major groups of animals to each other, using data from hundreds of genes sampled across as broad a diversity as possible. This work has produced some surprising results, such as placing the comb jellies rather than the sponges as the earliest diverging animals, and resolved old questions, such as the sister-group to the arthropods. I also work with the Cnidarian Tree of Life Project to resolve the evolutionary relationships of siphonophores and other cnidarians to each other. In addition, I have several projects focused on the developmental biology of cnidarians. These include descriptive studies at morphological and molecular levels and functional studies of development in *Nematostella vectensis,* a local sea anemone whose genome was recently sequenced.

Erika Edwards,
Assistant Professor, EEB

The advent of molecular phylogenetics has revolutionized the field of systematic biology. We are learning how different groups of organisms are related to one another at an astonishing pace, and with continuing technological advances that make DNA sequencing ever easier and ever cheaper, we are poised, over the coming decades, to really resolve the structure of the Tree of Life. It is an exciting time to be an evolutionary biologist.

Armed with a phylogeny, one can learn a lot about the evolutionary process. In the plant world, we have learned a great deal about relationships among all the major green plant lineages, and much in particular about the spectacular rise and subsequent diversification of the angiosperms (flowering plants) over the past 150 million years. I am interested in using phylogeny to investigate all aspects of plant evolution, though I am particularly interested in the evolution of physiological traits, and the complex interplay between form and function during plant adaptation. I have an ongoing interest in the evolution of succulence as a type of adaptation to arid environments. My PhD dissertation focused on the origin of the cactus life form, combining phylogenetics with anatomical and eco-physiological data to infer some of the earliest events in the evolutionary transition to a leafless, stem-succulent plant. This work resulted in several testable hypotheses about necessary 'ecological pre-conditions' that promote the evolution of this growth form. I hope to test these hypotheses directly by collecting additional data on two other groups of enigmatic desert succulents: the Anacampserotae lineage endemic to Southern Africa, and the Didiereaceae, endemic to Madagascar (and, notably, dubbed 'the cacti of the old world' due to their cactus-like morphology). It is becoming increasingly clear that the cacti, the Anacampserotae, and the Didiereaceae are all quite closely related, yet represent three independent radiations into arid environments, and three independent origins of relatively bizarre succulent life forms. This new phylogenetic picture raises some terrific questions. What did the common ancestor of these plants look like, where did it live, and how did it function? What do the cacti functionally have in common with Didiereaceae and Anacampserotae, and how do they differ? Can we infer the ecological conditions that may have triggered such dramatic morphological innovation in these lineages, and were they similar in each case? These are on-going questions in my lab, and luckily, answering them requires not only labwork, but also a great deal of fieldwork in many beautiful places around the globe.

I am also initiating a project closer to home, and one that will hopefully get a lot of Brown undergraduates out in the field with me. Leaves are incredibly

diverse - in traits that are obvious to anyone walking through the woods (size, shape, etc.) - but they are equally diverse with regard to their finer anatomy and function. We know from both theoretical and empirical studies that certain combinations of leaf traits are optimal under certain environmental conditions. We infer from this that adaptive evolution has been the primary engine that has produced the great diversity of leaf form that we see today, but studies actually documenting this are sparse at best. My lab will be looking at leaf evolution in *Viburnum*, a lineage of mostly forest understory trees and shrubs that exhibit a wonderful diversity of leaf form. We'll be working closely with the great collection of *Viburnum* species at the Arnold Arboretum in Boston, as well as the handful that grow wild in Rhode Island. Particular questions we'll be asking include:

1. Are major habitat/climate shifts driving evolutionary divergences in leaf form?
2. Are traits pertaining to hydraulic capacity and traits pertaining to drought tolerance evolving independently? Do some leaf traits exhibit greater evolutionary lability than others?
3. How are evolutionary changes in leaf form integrated with other, often overlooked organismal-level traits, such as shifts in branching architecture and/or leafing and flowering phenology?

I arrived at Brown from a two year postdoc in Hawaii, where I was researching what have been traditionally ecological questions of C3 and C4 grass distributions and abundance. It was a fun and (ultimately, I think) very productive exercise to stretch the emerging field of 'phylogenetic biology' to new areas. In this regard it is especially exciting to have finally arrived in the Brown EEB department, which boasts such strong research groups in ecology, evolution, and functional morphology- a ripe environment for more creative collaboration. I'm also excited to begin teaching in the Fall of 2008, as I think Brown undergrads will quickly see the beauty and power of 'tree-thinking'.

Heather Leslie,
Assistant Professor, EEB & Center for Environmental Studies

My interests in ecology, evolution and the environment date back to my childhood in Plymouth, Massachusetts, just an hour from Brown. While in high school, I served on the town's beaches advisory committee, where I gained firsthand experience with the often heated and divisive debates surrounding coastal management and the role of science in informing those discussions. This experience encouraged me to study biology and environmental science as an undergraduate at Harvard. Post-Harvard, I worked in a biosphere reserve in Yucatan, Mexico and then on the Maine Coast, seeking examples of ways that people have resolved the challenges posed by balancing human needs with environmental protection.

Understanding the roots of these challenges and helping to resolve them motivate my work, which is focused on the ecology, policy, and management of coastal marine ecosystems. I am interested in the ecological and social processes that link people and marine ecosystems, and how to integrate science into marine policy and management more effectively.

In terms of coastal ecology, I have found that differences in nearshore oceanography and other environmental factors can contribute to variation in reproduction and other key life history traits in barnacles, which are dominant and ecologically important marine animals on rocky shores. Such heterogeneity in reproduction may significantly impact the effectiveness of marine reserves and other management strategies, as reserves are often expected to act as sources of marine larvae. Building on field experiments I conducted on the Pacific coast, I plan to investigate the ecological and evolutionary drivers of reproductive variation in a variety of New England intertidal species, and the influence of this variation on population and community dynamics.

Increasing awareness of declines in many ecosystem services provided by marine systems has led to increasing interest in more integrated approaches to marine management and conservation. Marine reserves and other types of protected areas are considered a key tool in implementing marine ecosystem-based management. However, a number of questions remain: When designing networks of reserves, what is the added value of incorporating information on ecological processes (e. g., reproduction)? How can information on ecosystem services be incorporated into ocean zoning? Other developing projects are focused on assessing the ecological and social effectiveness of marine ecosystem-based management efforts.

My research also examines the linkages between human communities and coastal and marine ecosystems. I am interested in how ecosystem services respond to environmental and social change, and how natural and anthropogenic disturbances influence the availability of services through time. I am leading a collaborative project in the Gulf of California to model the impacts of multiple fishing sectors on a key member of the nearshore fish community – the spotted rose snapper – and to explore how these impacts contribute to the well-being of the local human community.

I am synthesizing information and approaches from the natural and social sciences to advance understanding of the connections between coastal ecosystems and the human communities that rely on them. A major output of this work is *Ecosystem-Based Management for the Oceans: Applying Resilience Thinking*, to be published by Island Press next year. Drawing insights from multiple disciplines, this edited volume will provide practical guidance and inspiration to scientists, practitioners, and students who seek to restore the oceans' bounty.

I'm thrilled to be at Brown! With a joint appointment in Ecology & Evolutionary Biology and the Center for Environmental Studies, I have opportunities to interact with students and faculty interested in a wide range of subjects related to coastal ecology and management. This semester I taught Marine Conservation Science and Policy, an upper-level course that drew in students from biology, geological sciences, international relations, anthropology, and sociology. I anticipate developing other courses in ecology and marine conservation science and policy in the coming years. I also look forward to collaborating with other faculty associated with Brown's Environmental Change Initiative and with the scientists at the Marine Biological Laboratory.

Jeremy Rich,
Assistant Professor, Center for Environmental Studies

Microbes are the most abundant organisms on Earth, and their activities provide the foundation for the planet's life support systems. The development of an oxygenated atmosphere was made possible by innovations in bacterial metabolisms, ultimately leading to the emergence of animals and plants. Today, microbial activities continue to drive biogeochemical cycles involved in climate regulation and other processes. Yet, only a tiny fraction of microbial diversity has been identified and an even smaller fraction is well understood. Studying newly discovered microbial species and their role in ecosystems is what I find most exciting.

Trained as a microbial ecologist, I use molecular and biogeochemical approaches to investigate the role played by microbes in environmental processes. My research focuses primarily on the key role that different microbial groups play in the nitrogen cycle. Human activities have substantially increased inputs of biologically available nitrogen, leading to profound environmental changes. My work with the nitrogen cycle has consequences for understanding controls on climate change and nutrient pollution.

I came to Brown from Princeton University, where I had the opportunity to participate in a research expedition to the tropical Pacific Ocean, off the coast of Peru. Through a chain of naturally occurring events, beginning with persistent and intense upwelling of nutrients from the deep ocean, to high production of phytoplankton biomass in the surface waters, and decomposition of sinking biomass, a massive area devoid in oxygen persists off Peru. Through microbial processes, a globally significant fraction of biological nitrogen loss occurs in this zone of low oxygen water. In the past few years a completely novel pathway of nitrogen removal has been discovered, known as anaerobic ammonium oxidation (anammox). The anammox process short circuits the conventional nitrogen cycle, and thus, determining the relative contribution of anammox to nitrogen fluxes in natural systems is critical for developing predictive models of global environmental change.

Through my work in Peru, I demonstrated the environmental importance of the anammox mechanism. I found that anammox could explain all of the biological nitrogen removal in the water column. Meanwhile, in the sediments, I detected the highest anammox rates that have been reported. Because the bacteria carrying out anammox are completely novel, I am currently using molecular techniques to characterize these populations in Peru and beyond.

In contrast to the open ocean, human activities have substantially altered nutrient dynamics in coastal ecosystems through inputs of nitrogen from fertilizer run-off, NOx emissions, and sewage effluent. I have been examining pathways of nitrogen removal in Chesapeake Bay. This involves sampling along environmental gradients from the freshwater to the saline part of Chesapeake Bay. I found that anammox was an important mechanism in some locations in Chesapeake Bay but not at all locations. This spatial variability is consistent with the dynamic nature of Chesapeake Bay and estuaries in general. My work demonstrates that estuarine systems serve as useful model systems to elucidate the environmental controls on nitrogen cycling processes, including anammox. I plan to expand my work in coastal systems to New England, and I am currently developing models to predict when and where different nitrogen processes will be important.

I am very pleased to be at Brown, and I am finding it very easy to feel at home here, professionally and personally. I am looking forward to teaching courses in microbial diversity and the environment, and involving undergraduate and graduate students in my research. Through my affiliations with Environmental Studies, the Environmental Change Initiative, and the Brown-MBL program, I am excited about the possibilities for developing new synergies at Brown.

Dov Sax,
Assistant Professor, EEB & Center for Environmental Studies

I've arrived to Brown with two large academic passions. First, I want to understand how and why species invade, how they do (or don't) integrate into existing communities, and what all of this tells us about the processes that limit how many species can be shoved into any one quadrat, state, island or nation. Second, I'm concerned about species extinction, particularly in understanding how we can minimize the number of extinctions caused by the interaction between global climate change and human land use.

My passion for understanding invasions began in an undergraduate ecology lab course at UC Berkeley. We were in the field learning 'nearest-neighbor' analysis techniques, using an invasive plant, the ribwort plantain (*Plantago lanceolata*). We studied the plant in a grassland habitat, with plans to sample it next in an adjacent woodland dominated by introduced eucalyptus trees. As the day wore on and the planned activities took longer than anticipated, both instructors suggested that we could skip sampling the plantain in the eucalypt woodland, because nothing was expected to grow there. When we were done they took us into the woodlands. To everyone's surprise we found a broad diversity of plant life growing under the eucalyptus trees; the plantain was there, but so were strawberries, grasses, poison oak and many others. I was hooked. What were all these plants doing living in a system dominated by an exotic? How did all of these species, with different evolutionary histories, manage to live together? Was this system less diverse than woodlands dominated by native oak and bay trees? I spent a year-and-a-half answering that last question (as my senior thesis) to discover that the answer was no; eucalypt woodlands had as many species, but of a very different species composition, as native woodlands.

Following a 2-year break, I went off to graduate school at the University of New Mexico to work with Jim Brown. It was a good fit and I had a wonderful experience. I studied biogeographic patterns of species invasions across latitudinal scales, as well as local-scale patterns of plant invasions in California and Chile. I then went off to the

University of California at Santa Barbara to work with Steve Gaines for a postdoc. (*former EEB faculty- Ed.*)

At SB I focused my attention on species invasions, this time on how diversity was changing on oceanic islands around the world. One of the most intellectually troubling patterns that I found, which I still haven't found a satisfactory answer for, is the nearly perfect correspondence between the number of native and exotic plants on islands. It turns out that oceanic islands and island archipelagos have almost exactly one native plant for every one exotic plant that's become naturalized. The slope between native and exotic plant richness across islands is 0.95 and the R^2 value is 0.98. For example, New Zealand has 2000 native and 2000 exotic plant species. I've now ruled out the possibility that this pattern is due to some sort of maximum species richness concept, including species saturation. I am hoping to discover what has caused the pattern, what this pattern might mean for the persistence of native species over the long term, and how we can expect diversity to change on these islands in the future. I'm also really interested in the role that climate may play in species extinctions. As a first-year graduate student I became really depressed when I realized just how frequently and how far (often more than a 1000 miles) species have shifted their geographic ranges in the past as climate changed. The trouble, in today's world, is that many species will be blocked from shifting their ranges by urban sprawl and large agricultural regions. There is absolutely no way the tortoise (inset picture) is going to be able to cross from a protected area through urban Athens, Greece. The situation is no different for a coastal-endemic species in the US that needs to pass through Los Angeles, Miami or New York. With funding from NSF and the Cedar Tree Foundation I have co-organized a working group of approximately 30 people (scientists, policy makers, ethicists, economists, and lawyers) that will begin addressing the sticky and complex scientific and policy issues needed to help develop strategies for addressing this pending biodiversity crisis.

Brown is a wonderful place to be based for tackling the research questions that interest me most. To be honest, I really can't imagine any place I'd rather be than at Brown University. I feel as if I've won the lottery. The sense of community, good-will, intellectual passion, and commitment to education at Brown are intoxicating. I look forward to becoming an active part of what makes this such a great place.

Katherine Smith,
Assistant Professor, EEB

Having recently arrived at Brown I can say my life has come full circle. I'm a native New Englander, and although my Boston accent has not returned (it may neva), I feel like I'm home. My college days began at the University of Massachusetts Amherst, though it wasn't long before I spent a semester on exchange at the University of New Mexico and was drawn west. I transferred to UNM where I graduated with a degree in Biology and a desire to pursue an academic career in Ecology. It was in the graduate program at the University of California Santa Barbara that I found my calling.

In his book Blink, Malcolm Gladwell muses about the value of rapid cognition, about the kind of thinking that happens in a blink of an eye. 'When you meet someone for the first time, or walk into a house you are thinking of buying, or read the first few sentences of a book, your mind takes about two seconds to jump to a series of conclusions that are really powerful and really important and, occasionally, really good.' I had a Blink moment when I discovered the discipline that subsequently formed the foundation of my academic career – Conservation Medicine. Somehow, it just grabbed me. Conservation Medicine is an emerging field that resides at the intersection of environmental change, conservation biology, and public health. At the advent of a century characterized by human induced changes to the environment, rapid human population growth, and the emergence of new infectious diseases, Conservation Medicine is indeed timely!

Within the purview of Conservation Medicine I am interested in three broad topics: 1) the role of environmental change in the emergence of human and wildlife infectious diseases, 2) the implications of emerging infectious diseases for public health and biological conservation, and 3) best management practices for regulating the mechanisms that facilitate the emergence of infectious disease. My principal approach in exploring these topics has been to examine the biogeographical dynamics and regulation of human and wildlife infectious diseases using a combination of meta-analyses, theory, and field studies. Recent projects I've worked

on include the globalization of human infectious diseases, the establishment of introduced black rat parasites in endemic rodent populations on the southern California Channel Islands, the role of infectious disease in species extinction and endangerment, and the utility of ecological theory in programs that aim to control infectious disease.

As a scientist my goals are twofold. First, I aim to combine cross-disciplinary techniques to obtain an integrated understanding of the links between environmental change and infectious disease emergence. Second, I strive to use this knowledge in a manner that benefits the greater global community.

I'm presently working on two research initiatives that meet these goals. The first focuses on the public health and conservation implications associated with the global trade in wildlife. Over half a million shipments containing >1.68 billion live animals were traded by the U.S. since 2000. Nearly 90% of these were imports containing wild-caught animals intended for commercial purposes (i.e. pet sales). Using data on the scope and scale of the live animal trade, and by studying the dynamics of infectious disease spread along trade routes, I'm compiling scientific evidence to help guide industry and policy initiatives to reduce the externalities of wildlife trade that pose implications for conservation and human health. The second project I'm working on examines the link between global warming, the spread of invasive water hyacinth, and the emergence of mosquito-borne disease. There is anecdotal information from the southeastern U.S. that mosquito-borne disease outbreaks are occurring in close proximity to water bodies experiencing rapid invasion by the South American aquatic plant, water hyacinth. This spring we will set up mesocosm experiments and conduct field surveys to examine linkages between water hyacinth, water temperature, nutrient loading, mosquito abundance and the prevalence of mosquito-borne infectious agents – specifically West Nile Virus. Much of our field research will be conducted in southern New England, the northernmost occurrence of water hyacinth, where the range appears to be expanding as warming occurs.

Brown's interdisciplinary atmosphere make this a great home for a research program in Conservation Medicine. I feel very fortunate to be here and look forward to interacting with the University's diverse and stellar faculty and student body.

2007 Fall Seminars

Brown Bag seminars usually catch up on research and work in progress within EEB, and the more formal colloquium series features speakers from outside the University.

Brown Bag Seminars

SEPT 14 **Erica Lasek-Nesselquist,** Graduate Student, BrownUniversity. Evidence of molecular recombination in *Giardia intestinalis*.

SEPT 21 **Pedro Flombaum,** EEB Graduate Student, Ph.D. defense. The role of biodiversity on ecosystem functioning: the Patagonian steppe as a model.

SEPT 28 **Matt Ogburn,** Graduate Student, Brown University Anatomical variation in Cactaceae sensu lato.

OCT 5 **Callie Harper**, Graduate Student, Brown University. Gross morphology of the melon and its tendinous connections to the facial muscles in bottlenose dolphins.

OCT 12 **Kimberly Bostwick,** Curator of Birds and Mammals, Cornell Museum. The evolution of wing morphology in the neotropical manakins (Aves) for producing wing sounds in courtship.

OCT 19 **Regina Campbell-Malone**, Postdoctoral Research Associate, Brown University. The biomechanics of blunt trauma from vessel-whale collisions.

OCT 26 **Nick Gidmark,** Graduate Student, Brown University. Anamniotic snakes: a how-to guide on convincing fish to use serpentine locomotion.

NOV 2 **Jennifer Knies,** Postdoctoral Research Associate, Brown University. The limits of evolution at cold temperatures.

NOV 9 **Bryan Nowroozi,** Graduate Student, Brown University. Whole body lift and fluid flow during pectoral fin locomotion of the Northern Spearnose Poacher.

NOV 16 **Colin Meiklejohn,** Postdoctoral Research Associate, Brown University. Mito-nuclear interactions in flies.

NOV 30 **Justin Shaefer,** Postdoctoral Research Associate, Brown University. Batoid wing skeletons: Multi-scale mechanical behaviors of serially arranged skeletal elements.

DEC 7 **Jose (Pepe) Iriarte-Diaz,** Graduate Student, Brown University. Kinematic plasticity in bat flight.

Monday Colloquia

SEPT 10 **Steven Haddock,** Monterey Bay Aquarium. Biodiversity and bio-optics of deep-sea gelatinous zooplankton.

SEPT 17 **Reto Nyffeler,** Institute for Systematic Botany, Zurich. The diversification of cacti - insights from phylogenetic and comparative evolutionary investigations.

SEPT 24 **Sara Hotchkiss,** University of Wisconsin. On Hawaiian time: climate change, ecosystem development and the moss that eats mountains.

OCT 15 **Sharon J. Hall,** Arizona State University. Long-term human manipulation of ecosystem services in the arid southwestern US.

OCT 22 **Dimitri Petrov,** Stanford University. Signatures of pervasive adaptation in the *Drosophila* and human genomes.

OCT 29 **Anne Pringle,** Harvard University. Last chance to know? Building the biogeography of an ectomycorrhizal fungus using the literature and a genome.

NOV 5 **David Fastovsky**, University of Rhode Island. Extinction of the Dinosaurs, 65 My.

NOV 19 **David Fox,** University of Minnesota. Ecosystem structure and climate change during the transition to modern grassland in the Great Plains.

NOV 26 **Matt Carrano,** Smithsonian Institution. Dinosaur diversity, evolution, and the fossil record

DEC 3 **Sohini Ramachandran,** Harvard University. The signature of historical migrations on human population genetic data.

New Publications

Abt D., K.L. Montooth, D.M. Rand & 140 others. 2007. *Drosophila* 12 Genomes Consortium Evolution of genes and genomes on the *Drosophila* phylogeny. Nature 450:203-218

Azizi, E., T. Landberg, & R.J. Wassersug, 2007. Vertebral function during tadpole locomotion. Zoology 110:290-297.

Bern, C.R., **S. Porder,** & A.R. Townsend. 2007. Erosion and landscape development decouple strontium and sulfur in the transition to dominance by atmospheric inputs. Geoderma 142:274-284.

Dean, M.N., **E. Azizi,** & A.P. Summers. 2007**.** Uniform strain in broad muscles: Active and passive effects of the twisted tendon of the ratfish, *Hydrolagus colliei*. Journal of Experimental Biology 210: 3395-3406.

DePristo, M.A., D.L. Hartl & **D.M. Weinreich.** 2007. Mutational reversions during adaptive protein evolution. Molecular Biology and Evolution 8:1608-1610.

Edwards, E.J., C.J. Still & M.J. Donoghue. 2007. The relevance of phylogeny to studies of global climate change. Trends in Ecology and Evolution 22: 243-249.

Flatt, T.,& D.E.L. Promislow. 2007. Still pondering an age-old question. Science 318:1255-1256.

Flatt, T.,& T.J. Kawecki. 2007. Juvenile hormone as a regulator of the trade-off between reproduction and life span in *Drosophila melanogaster.* Evolution 61:1980-1991.

Haney RA, B.R. Silliman, A.J.Fry, C.A.Layman, D.M. Rand 2007. The Pleistocene history of the sheepshead minnow (*Cyprinodon variegatus*): Non-equilibrium evolutionary dynamics within a diversifying species complex. Molecular Phylogenetics & Evolution 43:743-754.

Janis, C.M. 2007. Evolutionary patterns and paleobiology. In D. R. Prothero & S. E. Foss (eds.). Artiodactyla. Johns Hopkins Press, Baltimore. Pp. 292-302.

Janis, C.M. 2007. An evolutionary history of browsing and grazing ungulates. In I. J. Gordon & H. H. T. Prins (eds.). The Ecology of Browsers and Grazers. Springer-Verlag, Berlin. Pp. 21-45.

Lafferty, K.D., **K.F. Smith,** & E.M.P. Madin. 2007. Terrorism as a disease: improving homeland security using lessons from infectious disease ecology. In Natural Security: a Darwinian approach to a dangerous world. Sagarin, R. and T. Taylor (eds.). University of California Press, Berkeley, CA.

Meiklejohn, C.D., K.L. Montooth & D.M. Rand 2007. Positive and negative selection on the mitochondrial genome. Trends in Genetics 23:259-63.

Morse, D.H. 2007. Mating frequencies of male crab spiders, *Misumena vatia.* Journal of Arachnology 35:84-88.

Nezat, C.A., J.D. Blum, R.D. Yanai, & **S.P. Hamburg.** 2007. A sequential extraction to determine the distribution of apatite in granitoid soils with application to weathering at the Hubbard Brook Experimental Forest, NH, USA. Applied Geochemistry 22:2406-2421.

Park, B.B., R.D. Yanai, M.A. Vadeboncoeur & **S.P. Hamburg.** 2007. How to estimate root biomass: pits, cores, or allometric equations. Soil Science Society of America Journal 71:206-213.

Patek, S.N., **B.N Nowroozi,** J.E Baio, R.L Caldwell, & A.P. Summers. 2007**.** Linkage mechanics and power amplification of the mantis shrimp's strike. Journal of Experimental Biology 210: 3677-3688.

Peters, D., **O. Sala,** C. Allen, A. Covich, & M. Brunson. 2007. Cascading events in linked ecological and socio-economic systems: Predicting change in an uncertain world. Frontiers in Ecology and the Environment 5: 221-224.

Porder, S., O.A. Chadwick & G.E. Hilley. 2007. Chemical weathering, mass loss and dust inputs across a climate by time matrix in the Hawaiian Islands. Earth and Planetary Science Letters 258:414-427.

Porder, S., P.M. Vitousek, O.A. Chadwick, C.P. Chamberlain, & G.E. Hilley. 2007. Uplift, erosion, and phosphorus limitation in terrestrial ecosystems. Ecosystems 10: 158-170.

Roberts, T.J., B.K. Higginson &F.E. Nelson. 2007. Muscle strain is modulated more with running slope than speed in wild turkey knee and hip extensors. Journal of Experimental Biology 210: 2510-2517.

Sax, D.F., et al. 2007. Ecological and evolutionary insights from species invasions. Trends in Ecology and Evolution 22: 465-471.

Shingleton, A., W.A. Frankino, **T. Flatt,** H.F. Nijhout, & D. Emlen. 2007. Size and shape: the developmental regulation of static allometry in insects. BioEssays 29:536-548.

Skeldon, M., M.A. Vadeboncoeur, **S.P. Hamburg** &J.D. Blum. 2007. Terrestrial gastropod responses to an ecosystem-level calcium manipulation in a northern hardwood forest. Canadian Journal of Zoology 85:994-1007.

Smith K.F., D.F. Sax, S.D. Gaines, V.Guernier, & J.F. Guegan. 2007. Globalization of human infectious diseases. Ecology 88: 1903-1910.

Vadeboncoeur, M. A., **S.P. Hamburg,** & R.D. Yanai. 2007. Validation and refinement of allometric equations for roots of northern hardwoods. Canadian Journal of Forest Research 37:1777-1783.

van Wesenbeeck, B.K., **C.M. Crain, A.H. Altieri, & M.D. Bertness.** 2007. Distinct habitat types arise along a continuous hydrodynamic stress gradient due to the interplay of competition and facilitation. Marine Ecology Progress Series 349: 63-71.

Vellend, M., L.J. Harmon, J.L. Lockwood, M.M. Mayfield, A.R. Hughes, J.P. Wares, & **D.F. Sax.** 2007. Effects of exotic species on evolutionary diversification. Trends in Ecology and Evolution 22: 481-488.

Villa-Cuesta, E., E. Gonzalez-Perez & J. Modolell. 2007. Apposition of iroquois expressing and non-expressing cells leads to cell sorting and fold formation in the *Drosophila* imaginal wing disc. BMC Developmental Biology 7:106.

Zabin, C. J., and **A.H. Altieri**. 2007. A Hawaiian limpet facilitates recruitment of a competitively dominant invasive barnacle. Marine Ecology Progress Series 337:175-185.

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