Greetings from EEB. It has been a hectic, but extraordinarily eventful semester. We will be welcoming four new faculty members in the next few months! In January Dan Weinrich and Stephen Porder will be joining us. Dan, an evolutionary biologist from the Lewontin and Hartl Laboratories at Harvard, has a strong computational background from his previous life in computer science and was hired as part of the Molecular Computational Biology Initiative. Stephen, an ecosystem ecologist from Peter Vitousek’s laboratory and the Conservation Biology Group at Stanford, was hired as part of the Environmental Change Initiative. Stephen’s research focuses on the biogeochemistry of tropical forest ecosystems. In July Erica Edwards and Casey Dunn will join us. Erica and Casey both did their graduate work at Yale and are currently postdocs hard at work in Hawaii. Erica works on the systematics and environmental physiology of plants and Casey works on the systematics, development and biology of siphonophores, a wicked cool group of hydrazoans. We are just ecstatic about the arrival of our “super cohort”.

Most of us have been busy moving. Renovated laboratories on the 4th and 5th floors of the BioMed Center were recently completed and the Brainerd, Schmitt, Rand, Tatar and Roberts’ labs have moved into nice new digs. Virtually every other EEB person in the BioMed Center has also been shuffled around in one way or another as we make the best use of our still limiting space. For some reason I still occupy the bowels of Walter Hall. We are also currently searching for a conservation biologist and have a strong group of applicants.

A few congratulations are in order. Marc Tatar just became our youngest Full Professor, edging out David Rand by a hair. Annie Schmitt was just elected President of the Society for the Study of Evolution. Well done!

Angela Allen: graduate student from the University of Rhode Island – Sala lab
Joseph Bahlman: graduate student from the University of California, Davis – Swartz lab
Rondi Butler: lab manager – Tatar lab
Sandra DeAngeles: office assistant – Walter Hall
Patrick Flight: graduate student from Duke University – Rand lab
Erica Garcia: postdoc., Ph.D., Michigan State University - Bertness lab
Gretchen Gee: postdoc., Ph.D., Brown University - Tatar lab
Nicholas Gidmark: graduate student from the University of Minnesota – Brainerd lab
S. Tonia Hsieh: postdoc., Ph.D., Harvard University - Roberts lab
Bryan Nowroozi: graduate student from the University of California, Berkeley – Brainerd lab
Daniel Riskin: postdoc., Ph.D., Cornell University - Swartz lab
Eugenia Villa-Cuesta: postdoc., Ph.D., Universidad Autónoma de Madrid, Spain - Tatar lab
Sarah Taylor: research assistant – Brainerd/Swartz lab
As the end of fall semester comes to a close, experiments in the greenhouse and plant growth chambers keep rolling along. *Arabidopsis thaliana* is the main species in research these days because it is the standard model organism used in plant genetics. The EEB *Arabidopsis* folks are complemented in this endeavor by Mark Johnson, of the MCB department, and his laboratory group. Mark uses pollen tube growth and guidance as a model system to understand the mechanisms of cell interactions, guidance of migration and polarity determination. He also studies the fertilization process in flowering plants because the success of this fundamental component of the flowering plant life cycle depends on the lengthy and precisely guided journey of the pollen tube, a cell that delivers two sperm to the female gamete. Mark’s main approach is to identify mutant plants that can’t reproduce, and figure out what has gone wrong with them. Growing *Arabidopsis*, MCB graduate student Aubrey Frank, along with postdoc Julian Wong and undergrads Adisorn Chaibang, Keith Heyward and Azeem Kaka are studying a mutant that delivers defective sperm that can’t initiate seed formation. Their hypothesis is that this mutant does not express a critical protein that normally interacts with female gametes to mediate fertilization. Research assistant Althea Moore and undergrad Mark Tuttle study an *Arabidopsis* mutation that disrupts pollen tube guidance – the pollen tubes can’t find their way to female gametes. This defective gene is very similar to a human gene, so they hope to use the pollen system to understand how it works.

From the Schmitt lab, undergraduate Roxanne Palmer has completed an interesting experiment in the plant growth chambers using *Arabidopsis thaliana*. Her research focuses on trichomes, which are specialized epidermal cells that resemble tiny hairs on leaves and stems. The aim of the experiment was to examine the effect of trichomes on the ability of the plant to withstand drought stress. The results of this experiment will shed light on whether or not trichomes are a means by which *Arabidopsis* copes with the stressing effects of drought.

Congratulations to Schmitt lab graduate student Eric Von Wettburg who has recently received his doctorate. Eric will be missed here in the Plant Environmental Center, a long time greenhouse user with many successful plant experiments under his belt. Good luck Eric!

**The iGem Competition**

*by John Cumbers*

“synthetic biology” is emerging from those at MIT, Berkeley and elsewhere that hopes to be able to engineer DNA in the same way that electronic engineers work with electrons. The core concept is the “Bio Brick” registry, a standardized list of 600 “parts” of DNA that was sent to each of the competing teams in this year’s International Genetically Engineered Machines Competition, held at MIT on November the 4th and 5th this year. Primarily undergraduate driven, I played a role in bringing together students and a cross-disciplinary faculty ranging from physics to biology to take part in iGEM 2006. (www.igem2006.com). With the help of a grant from the President’s Office, the 8 undergraduates set up and worked in an iGEM lab in J. Walter Wilson for 12 weeks over the summer, designing and modeling novel systems to function inside the bacteria *E. coli*. They learned how to clone and ligate the various parts together to form two projects, one a game of bacterial freeze-tag, and the second a tri-stable toggle switch for use in future biological computing applications. The team received an honorable mention during the prize giving and whilst the final project is still underway, they did produce and send to MIT another dozen parts for the registry, which now contains over 1000 parts for the 2007 teams. The project provided a great experience for undergraduates to do hands-on science in the lab and also for me, as an excellent opportunity for to learn about the challenges of mentoring and managing in a research environment.
Motile sperm cells face an unique evolutionary paradox. As motile cells they are dependent on ATP production, but production of ATP requires the function of a class of genes that cannot respond to selection in males. Of course, as a member of the Rand lab, the genes I study are found in the mitochondria. Mitochondria are the main energy source in all cells and production of this energy requires the expression of 13 mitochondrially encoded proteins involved in oxidative phosphorylation. The mitochondrial genome, however, is maternally inherited. Therefore, traits that are affected by mitochondrial alleles can only be selected for in females, and mitochondrial genomes that are maladaptive in males only are unable to respond to selection. In sperm, one of the central components is mitochondria, and in many species it is known that mitochondrial mutations lead to poor sperm performance. How sperm evolve in light of this system has been the center of my research. When I arrived at Brown, I had a clear understanding of where this research would take me. We predicted that introducing divergent mitochondrial haplotypes would disrupt mitochondrial function and thus sperm performance, as had been suggested by research in mammals and birds. Describing this disruption both functionally and genetically would comprise the rest of my dissertation. Unfortunately, a large sperm competition experiment (a standard sperm performance assay in flies) failed to show any effect of mitochondrial haplotype on sperm performance. This was despite our lab seeing an effect in other fitness traits. Although this experiment may have done little to shed light on the paradox I described above, it taught me a powerful lesson; flies are different from mammals. In many ways this is obvious, even in sperm. Why these differences should reduce the influence of mitochondrial genes on sperm performance is unclear, but they are worth noting. Flies have sperm that are drastically different from the canonical swimming sperm we are all familiar with. In fact, fly sperm is huge. In one species, a single sperm can measure six centimeters, twenty times the length of the fly. It also doesn’t swim though it does wiggle, and somehow maneuver within the female reproductive tract. But unlike mammalian sperm, which literally race to the egg, fly sperm are many times the size of the reproductive tract, making swimming through fluid impossible and unnecessary. The mitochondria are also drastically different. Rather than having a sperm midpiece packed with many mitochondria, fruit flies have two giant mitochondrial derivatives that run the entire length of the sperm (affectionately referred to as “The Things” by Rand lab members). These derivatives are also highly derived structurally, making their exact function unknown. Still, like most all other organisms, a central component of fly sperm is the mitochondrion, though a weird one. And still, many other lines of evidence suggest that males must overcome this inability of mitochondrial genes to adapt to male function. For example, almost a third of nuclear encoded proteins involved with oxidative phosphorylation have two paralogs within the genome. In every case the duplicate copy is testis-expressed. How this and other data apply to mitochondrial genome evolution is unknown. It is highly suggestive, however, that to meet the energetic demands of the cell, sperm and testes must drastically alter the oxidative phosphorylation pathway. I have taken a step back and am addressing these issues more broadly, asking three basic questions. First, why and how are mitochondrial genomes uniparentally inherited in the first place? Second, what is the signature of selection on mitochondrial proteins found in the sperm and testes? And third, are testis-expressed mitochondrial proteins functionally divergent from their somatically expressed counterparts? I currently have no precise answers to these questions, though the experiments are under way. Stay tuned, more fun is yet to come.
In early November, two EEB graduate students, Keryn Bromberg and Pedro Flombaum, flew to Beijing, China to attend the START 2nd International Young Scientists’ Global Change Conference. They were among only one hundred students from all over the world chosen to attend the conference from a pool of 1,000 applicants. Keryn presented her work on global warming effects in New England salt marshes, and Pedro presented his work on biodiversity and ecosystem functioning in Patagonia. The two also presented posters at the Earth System Science Partnership Open Scientists’ Conference that followed. Discussing global environmental research over many Chinese banquets, the two perfected their use of chopsticks and can now pick up almost anything!

Maggie Brandt received a grant from the Cleveland Zoological Society to cover field work expenses in the Galápagos.

Lucia Vivanco was awarded with a START (global change System for Analysis, Research and Training) fellowship for studying at Brown, starting September 2006.

First-year graduate student Joseph Bahlman received a National Science Foundation Graduate Research Fellowship award. Thomas Flatt was awarded an Advanced Postdoctoral Fellowship, Swiss National Science Foundation for 2006-2008.

The EEB morphology group hosted the Northeast Regional Division of Vertebrate Morphology meeting on November 4, an all-day affair with participants coming from Massachusetts, Rhode Island, Connecticut and New York. The program consisted of 43 short talks on subjects ranging from the impact loading of goat horns to biomechanics of robotic animals. We were well represented in the program with seven presentations given by our graduate students and postdocs. These talks included several aspects of bat flight, adaptations for terrestrial locomotion, and burrowing adaptations of fishes. The day was capped off with dinner in the Providence Athenaeum.

Steve Hamburg was recently appointed to the Board of Directors of “Clean Air Cool Planet” NGO focused on facilitating mitigation of greenhouse gas emissions in the northeastern US. He was also appointed Vice Chair of the International Long-term Ecological Research Network and is serving as a consultant to Wal-Mart Stores on their sustainability initiative.

Jennifer Hughes Martiny has left to take a position near home in the EEB department at UC-Irvine. Good luck in your new endeavor, Jen!

Our graduate students continue to emigrate from our doors. We’ve had three successful Ph.D. defenses since the last newsletter. Melissa Lage (Hughes lab) defended on July 10th and has relocated to North Carolina. She worked on the microbial communities of salt marshes. Kristin Bishop (Swartz lab) defended on July 14th and taught comparative anatomy at Duke this Fall. She will commence a postdoc at UC-Davis in the coming term. Her thesis was on the mechanisms and origin of flight in bats. Eric von Wettberg (Schmitt lab) defended on December 4th and will also commence a postdoc at UC-Davis next term. Eric’s thesis focused on the basis for shade-avoidance patterns in the common jewelweed Impatiens capensis. It seems as if we have lost count of the number of our undergrads and graduate students ensconced there, making it the current Brown-West!

Marc Tatar recently received support for a long-anticipated collaborative study on the genetic basis of reproductive aging in baboons. The project will map genetic factors controlling variation in the onset, rate and outcome of female reproductive senescence. Congratulations to Mark Bertness on the publication of his book, Atlantic Seashores by Princeton University Press.
While in graduate school, I firmly believed that I would never work on a model organism; now, of course, most of the research done in my laboratory in the Department of Biology at the University of Pennsylvania is focused on flies. Even the most extreme flannel-wearing, quadrat-toting ecologists known to haunt Walter Hall are to some extent familiar with *Drosophila melanogaster*. Given the various tricks and genetic manipulations that can be performed, the thousands of mutant lines and constructs, the databases and stock centers, the fly remains one of the preeminent model organisms in biological and biomedical research: a golem of sorts, a scientifically engineered creation whose primary purpose appears dictated by its practitioners.

What of the fly as a whole organism, a member of an ecological community that exists outside of the laboratory environment? Somewhat surprisingly, precious little information is available. To be sure, *D. melanogaster* has been the traditional workhorse of empirical population and evolutionary genetics. A great deal is known about the process of adaptation, particularly at the molecular level, in this species. Unfortunately, the incorporation of *D. melanogaster* as a model organism in ecological genetics—defined by its founder, E.B. Ford, as the empirical study of adaptation by means of combined field observation/experimentation and laboratory genetics—has never materialized. Why? In his 4th edition of *Ecological Genetics* (1975), Ford writes: "the proportion of genetic research which has been conducted on *Drosophila melanogaster* and on *Neurospora* must be very large. Yet…it is hardly possible to speak of the ecology of *Neurospora*, while *Drosophila melanogaster* seems to provide remarkably poor ecological material: for little is known of its larval, and almost nothing of its imaginal, ecology.” More than 30 years later, during which time more than 20,000 research papers have been published on this species, not much has changed. Information regarding the natural history, ecology, and population dynamics of *D. melanogaster* in the wild is sparse and oftentimes anecdotal.

*D. melanogaster*, while a tropical endemic, has achieved a truly global distribution over the last several hundred years. *Drosophila* dogma has long held that this organism has no seasonal response or means to deal with a temperate environment. Temperate populations must therefore be recolonized each year from refugia (neotropical habitats, breweries, people’s basements, etc.). Until recently there were few data to contradict this scenario; it has since been discovered that *D. melanogaster* does in fact have a seasonal response. When adult females are exposed to low temperature and shortened daylength, traditional heralds of winter’s approach, they can express a form of reproductive diapause (in the strict sense, a genetically determined syndrome by which physiology is altered to promote survivorship during periods of unfavorable environmental conditions).

For the past seven years, I have been studying the adaptive dynamics of reproductive diapause and its role in both shaping life histories and determining population dynamics in the wild. We even do a fair amount of fieldwork (*sans* quadrats), although I admit this is a far cry from my days in the Bertness chain gang. One of the more interesting recent developments in the lab was the identification of the gene that underlies the variance for the diapause phenotype. In a fly population, individuals (genotypes) have either a high or low propensity to express diapause under the appropriate conditions. The frequency of these genotypes in natural populations varies predictably with both geography and season, and diapause genotype has significant impacts on a variety of other fitness related traits (lifespan, mortality rates, fecundity, development time, egg to adult viability, stress resistance). Using a combination of association mapping with recombinant inbred lines and complementation analyses with transposable elements, we identified the single gene (*couch potato, cpo*) that determines this variation. Subsequent sequencing and expression analyses demonstrated that diapause expression results from hypomorphic activity of *cpo*, and that there are a series of partial loss of function alleles segregating in natural populations. Now, we are poised to translate the molecular variation at *cpo* to performance-mediated differences in fitness and determine how these relationships are impacted by environmental heterogeneity over both space and time. In all of the free time that plagues junior faculty, I work on the ecological genetics of marine snails and spend time with my wife and three irreverent children.
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 8**
  - John Cumbers, Graduate Student, Brown University. How can FOXO, a single transcription factor affect so many different phenotypes?
- **Sept 29**
  - Daniel Riskin, Postdoctoral Research Associate, Brown University. The kinematics of bat movement between flights: walking, running, and landing.
- **Oct 6**
  - Alan Bergland, Graduate Student, Brown University. The genetic architecture of phenotypic plasticity in ovary size.
- **Oct 13**
  - Pedro Flombaum, Graduate Student, Brown University. Winds from the south: Biodiversity effects on ecosystem functioning, a natural experiment in the Patagonian steppe.
- **Oct 20**
  - Seeta Sistla, Graduate Student, Brown University. Linking aboveground and belowground responses to chronic soil warming: Characterizing the determinants of the net C balance of a northern temperate forest in a warming world.
- **Oct 27**
  - Lucia Vivanco, Graduate Student, Brown University. Linking plant diversity and belowground processes: litter decomposition in a South American temperate forest.
- **Nov 3**
- **Nov 10**
  - Joel Schwartz, College of Staten Island, City University of New York. Darwin’s “Intense Delight”: new thoughts about how the voyages of exploration fueled the growth of evolutionary biology.
- **Nov 17**
  - S. Tonia Hsieh, Postdoctoral Research Associate, Brown University. Lizards on water, fishes on land: locomotion at the air-water interface.
- **Dec 1**
  - Erica Lasek-Nesselquist, Graduate Student, Brown University. Variation and recombination in *Giardia*: Does *Giardia* get it on?
- **Dec 8**

**Monday Colloquia**

- **Sept 11**
  - Geerat Vermeij, University of California at Davis. How contingent is history? Innovations, fossils, and the power of selection.
- **Sept 18**
  - David Post, Yale University. Effects of a mobile predator on plankton community structure: size selective predation by alewives revisited.
- **Oct 16**
  - Richard Aronson, Dauphin Island Sea Lab, University of Alabama. Millennial-scale dynamics of coral reefs.
- **Oct 23**
  - John Hatle, University of North Florida. The physiology underlying phenotypic plasticity of reproduction and longevity in grasshoppers.
- **Oct 30**
  - Daniel Simberloff, University of Tennessee. Introduced species really are a huge problem - but not an insurmountable one.
- **Nov 6**
  - Andrew Rosenberg, University of New Hampshire. Ecosystem based management of coastal and ocean resources: can we get there from here?
- **Nov 13**
  - Peter Lucas, George Washington University. Seeds of war: the biomechanical designs of seed predators and their prey.
- **Nov 20**
- **Nov 27**
  - Colin Orians, Tufts University. From local to systemic induction: advantages of a whole plant perspective in plant-herbivore interactions.
- **Dec 4**
  - Eric von Wettberg, EEB Graduate Student, Ph.D. Defense. Landscape genetics and physiological mechanisms of population differentiation in shade avoidance responses in the herbaceous annual plant *Impatiens capensis*.
- **Dec 11**
  - Duncan Irshick, University of Massachusetts, Amherst. Selection on lizard communities: different strokes for different lizards.
New Publications


Feedback to the EEB Newsletter-
We would like to hear from you!

Comments and information are welcome to:
EEB Newsletter
Brown University
Box G-W
Providence, RI 02912.
Or email information to:
Bernadette_Horta@Brown.edu

To view this and previous newsletters in color visit our website at:
http://www.brown.edu/Departments/EEB/

Name: __________________________________ Undergraduate or Graduate – class Year ______________
Advanced Degrees Date & Institution__________________________________________________________
Email Address: _________________________________ Home Telephone ____________________________
Home Address: ___________________________________________________________________________
City __________________ State ___________ Zip Code _______ Telephone _____________________
Business Title: _______________________________ Business Phone _____________________________
Alumni Notes  (check if only for our files)____________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
Can we contact you for further information about your activities in Biology?   ___yes   ___no