BROWN

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Letter from the Chair

By Mark Bertness

It has been another busy, but exciting fall in EEB. We have two faculty searches underway. Annie Schmitt is heading a search for a plant phylogeneticist, which will fill our need for a systematic perspective in EEB. The second search, led by Osvaldo Sala, is a new Environmental Change Initiative (ECI) position for an environmental scientist, working on the EEB, Geology and Environmental Studies interface and will have an appointment in either Geology or EEB. This position and a similar one to be filled next year are intended to increase research and teaching collaborations among EEB, Geology, Environmental Studies and the Marine Biological Laboratory at Woods Hole (MBL). The ECI and our growing institutional partnership with MBL both continue to enhance and broaden EEB horizons. In September the ECI co-sponsored a Climate Change conference that brought a distinguished group of international experts to Brown. The conference was a resounding success and will become an annual addition to EEB activities, addressing different topics each year. Two courses by our new MBL colleagues have been approved for this year. An ecosystem modeling course taught by Ed Rastetter will feature an intensive three-week January session in Woods Hole followed by individual projects during the spring semester. A spring course on Human Impacts on Ecosystem Services will introduce students to the work being done in this area by both MBL and Brown scientists. We are also working to launch a M.S. program to give Brown undergraduates the opportunity for a fifth-year total emersion, research thesis masters degree in an MBL laboratory. Four Louisiana graduate students displaced by hurricane Katrina joined EEB for the semester. They added greatly to our experience and we wish them well upon their return to New Orleans. A couple of notable achievements: our very own Fred Jackson received a student award for excellence in undergraduate teaching for his freshman seminar on medicinal plants. Osvaldo Sala was elected President of the Scientific Committee on Problems in the Environment (SCOPE), a Paris-based, international environmental science group. He was also named to the scientific advisory board of The Nature Conservancy.

Jen Hughes Martiny married Adam Martiny this fall in Copenhagen, followed by a Departmental celebration on this side of the pond. Congratulations, Jen and Adam!

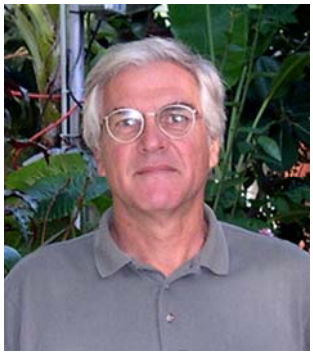
After a year-long battle with cancer, Steve Gatesy has been cancer free for the last month and a half. So we have much to be grateful for.

New to EEB in 2005

Manny Azizi: postdoc., Ph.D. from the University of Massachusetts-Amherst – Roberts lab
Marselle Alexander-Ozinskas: graduate student from Bates College – Sala lab
Maggie Ligia-Brandt: graduate student from the Universidad San Francisco de Quito – Witman lab
Martha Cooper: lab manager – Schmitt lab
John Cumbers: graduate student from Edinburgh University – Tatar lab
Pedro Flombaum: graduate student from the University of Buenos Aires – Sala lab
Lynn Hayden: Herbarium manager – Schmitt lab
Alida Kinney: lab manager – Brainerd lab
Kristy Kroeker: graduate student from the University of California-Santa Cruz – Bertness lab
Keith Metzger: post doc, Ph.D. from Stony Brook University – Anatomy lab
Lara Reichmann: graduate student from the University of Buenos Aires – Sala lab
Seeta Sistla: graduate student from Swarthmore College – Sala lab
Bud Tennille: EEB Applications Specialist
Ziaodong Tian: research engineer – Swartz lab
Lucia Vivanco: graduate student from the University of Buenos Aires – Sala lab
Amity Wilczek: postdoc, Ph.D. from Harvard University – Schmitt lab

In the Greenhouse

By Fred Jackson



Renovations at the Plant Environmental Center are the big happening this semester. The purchase and installation of three new growth chambers for Johanna Schmitt's lab was the catalyst that set off the project. Because these new units are water cooled, a cooling tower had to be installed, plus many new lines of piping and re-routing of wires. These renovations will facilitate new *Arabidopsis* research for the future.

Eric Von Wettberg (Schmitt lab) has been examining population differentiation between native New England jewelweeds (*Impatiens capensis*) and escaped ornamental jewelweeds collected from England.

The greenhouse will soon be looking like a New England salt marsh. Christine Holdredge, Keryn Bromberg, Eric Von Wettberg, Brian Silliman and Mark Bertness will be growing plenty of native and exotic *Phragmites* for eventual experimental transplanting into the salt marshes. No specific details have emerged but they should be interesting.

Devon Bradley, a graduate student in the Hughes lab, recently completed a multi-generational experiment demonstrating that pathogens and resources interact to promote plant diversity. She is following up this experiment by investigating the impact of pathogens on plants with different histories of exposure to disease in previous generations.

Rosanna Dent, undergraduate senior thesis project (Schmitt lab) is investigating whether naturally occurring Cryptochrome 2 (CRY2) alleles affect time to flowering, and if any effects are dependent on day length. She is using transgenic *Arabidopsis. thaliana* lines, each with one of three common, naturally occurring alleles, and is exploring five photoperiods, ranging from 8 to 14 hours.

Bioblitz 2005

Bioblitz 2005 took place on 17-18 June at Brown's Haffenreffer Estate and the adjacent Mount Hope Farm in Bristol, with EEB, along with the Haffenreffer Museum and the Mount Hope Farm hosting the event, which each year is organized and run by the Rhode Island Natural History Survey. Bioblitz is an effort to log as many species of organisms as possible at a site within a 24-hour period and thus can make a major contribution toward obtaining a first estimate of its biodiversity, as well as to document species of special concern. It is strictly a cooperative affair, and 102 scientists and volunteers participated this year, recording over 972 species. Bioblitz is also an effort to increase public awareness of our natural heritage and thus includes simultaneous educational activities for both adults and children, as well as a press briefing.

Not all the entries found could be identified to species – in many instances they have to remain "morphospecies", specimens that are clearly different from any others, but only identified to family or genus, usually because no specialist was present to provide a definitive ID. As you can imagine, it would be virtually impossible to have all areas of all the kingdoms represented by a specialist, but a glimpse of the species list (available on line – www.uri.edu/ce/rinhs/bioblitz.htm) reflects the limits imposed by the expertise present. For instance, most of the vascular plants were identified to species, and a substantial list was made (352); similarly, lichens were well represented with 88 species. Several vascular plant specialists were present, as well as a lichenologist. On the other hand, only 154 arthropods were recorded (124 insects), even though they make up roughly 3/4th of the total named species of organisms. The small order of dragonflies and damselflies yielded 22 species, but only five noctuid moth species were recorded, notwithstanding it being the largest moth family. Dragonfly experts were at this Bioblitz, but noctuid experts were not. Thus, Bioblitz made but a first step toward documenting the biodiversity of our Haffenreffer Estate, but provided a most welcomed kick-start, and we thank the Survey for its efforts.

Graduate Student Research

By Robert Haney

My research here at Brown possesses a duality that reflects the influences of some of the diverse assemblage of personalities within our department. While I do retain an interest in one of the primary research foci within the Rand lab, that of the mechanisms and evolutionary significance of cooperation between nuclear and mitochondrial genomes, much of my recent work has involved what might broadly be termed the phylogeography and molecular population genetics of fishes. Currently, most of my time is being invested in two ongoing projects. First, I am investigating the evolutionary forces responsible for the pattern of DNA sequence variation in the Caribbean reef fish species *Halichoeres bivittatus*. Initial surveys of mitochondrial sequence variation spurred by prior trips to Belize indicated a pattern that is consistent with an historical population expansion in this species. Although reef fishes would seem to inhabit a fairly stable environment, recent evidence suggests that populations of tropical species, both terrestrial and marine, may have been subject to the deleterious effects of past climate change, leading to fluctuations in population size. However, discriminating between this hypothesis and one of a selective sweep in the mitochondrial DNA requires a multi-locus approach. Current laboratory work involves the amplification and sequencing of loci in the nuclear genome for comparison to mitochondrial results.

Second, I am attempting to begin to elucidate the molecular basis of local adaptation in estuarine fishes. The sheepshead minnow, *Cyprinodon variegatus*, is a widespread species (Massachusetts to Mexico) that is endemic to coastal marsh habitats. However, our recent work suggests that gene flow is very low on a regional basis, allowing for potential adaptation to the widely divergent environments encountered by local populations. I am in the process of surveying candidate genes to look for the signature of selection at the gene level. My hope is to identify genes, such as those coding for enzymes, directly connected to easily scorable phenotypes, allowing an ascension of the biological hierarchy and fuller understanding of selection in wild populations, at least in some distant future! Of course, for someone who has primarily worked in invertebrate systems, such an undertaking allows a process of discovery regarding the confusing nature of vertebrate genomes, such as the complex intron/exon structure, and in teleosts, the presence of duplicate copies of many important genes. The hope is that results from *C. variegatus* will allow for a direct comparison with those from my NOAA/NERRS funded project investigating similar scenarios in another estuarine teleost, *Fundulus heteroclitus*, with a goal of determining whether different species respond in a similar manner to common environmental pressures.

Katrina

Hurricane Katrina brought several students to our group in September, all of who have spent the semester with us. In spite of the tremendous inconvenience (and worse) to them, they have added greatly to our department, and we will be sorry to see them go. **Shawn Vincent** is an ecomorphologist just finishing his graduate work at Tulane who works on problems of how animals exploit functionally difficult food resources, using animals as diverse as snakes, spiders, and insects. Shawn had hoped to take his final Ph. D. defense in September, but had to reschedule it – by the time you read this, he may have defended. He is off to Kyoto, Japan, on a postdoc next semester. Shawn's wife, **Di,** is finishing her undergraduate degree here this semester, in absentia from Tulane. She hopes to enter medical school. **Philip Bergmann** is an ecomorphologist from Tulane who studies the evolution of body elongation and limb reduction in lizards. **Rebecca Weaver** is a plant ecologist from Tulane who works on problems of regeneration and restoration of degraded tropical forests. She works in the Atlantic Forest in Brazil, one of the most endangered of habitats. **Cristina Lopez** is a plant evolutionary ecologist from the University of New Orleans, who is studying the effects of fragmentation on the population structure of cycads in Costa Rican forests. She is a student of Pam O'Neil (Ph.D. '91 from EEB), a former UNO faculty member and current assistant vice-president in Brown's Office of Research. In all, Brown has hosted nearly 100 students affected by the storm, the majority of them from Tulane. We wish all of them the best and for a rapid return to normal.

News Update

Fred Jackson receives teaching award

Kudos to Fred on receiving an Undergraduate Council Students (UCS) Award for "Excellence in Teaching". This is a real honor: only four awards were given campus-wide, two to lecture leaders and two to seminar leaders. Fred has taught a freshman seminar on ethnobotany (Botanical Roots of Modern Medicine) for the last three years during the autumn semester. The course focuses on medicinal plants, how they are used by different cultures, and the science behind their use.

We wish **Molly Przeworski** the best at her new position in the Department of Human Genetics, University of Chicago, where she moved in July.

Faculty positions

This year EEB is searching for a departmental position and is also participating in a search for the Environmental Change Initiative (ECI). The departmental search is for an evolutionary biologist who uses molecular phylogenetics and works with plants to study problems of evolutionary mechanisms and organismal diversity. This position will simultaneously fill two seriously perceived needs – for someone who uses modern phylogenetic techniques on a routine basis and at the same time works with plant systems. Modern phylogenetic analysis has become one of the big growth areas in evolutionary biology, and we have long felt that we needed a colleague who thinks full time about these issues. We have also realized that our representation in plant biology is inadequate, given the exciting new questions coming to the fore, and this position will begin to redress the balance.

The other position is for an environmental scientist who has complementary interests in environmental issues from a social science perspective. The precise area of expertise is open and the hire will have an appointment in either Geological Sciences or EEB, with a joint appointment in Environmental Studies. The ideal candidate will help to integrate programs and interests among the three groups. This will be the first appointment explicitly associated with the ECI, one of President Simmons' first initiatives in her Plan for Academic Enrichment. Additional hires in this area are anticipated in upcoming years as well.

We will be interviewing candidates at the beginning of the upcoming semester, so it will be an exciting and hectic (real *wild*!) time for us all, with lots of seminars, interviews, and receptions coming up. We hope to have a definitive update for you in the spring newsletter.

In August 2005, **Thomas Flatt** was an invited symposium speaker at the "Biology of Aging-an integrative approach" at the 10th Congress of the European Society of Evolutionary Biology in Krakow, Poland and also at the "Life Histories and Longevity" at the Institute of Biology & Leiden University Medical Center in the Netherlands.

Shane Heschel is an assistant professor in the Department of Biology at Colorado College.

John Stinchcombe is an assistant professor in the Department of Botany at the University of Toronto

Jay Lennon was selected to attend this year's DIALOG meeting, a leadership symposium for recent Ph.D.s in the aquatic sciences.

EEB faculty and students participated in the 2005 Dunkin' Donuts Marathon Relay in Woods Hole, MA along with our friends at the Marine Biological Laboratory. EEB entered two teams: ***Walter haul*** won Second Place in the Mixed Open Division. Congratulations to the entire team of **Maggy Brandt, Jim Palardy, Andrew Clifford and Andrew Altieri!**

The other EEB team, ***Ec-haul-ogy*** **[Heather Reed, Lindsey Ryckman, Philip Bergmann, Marselle Alexander-Ozinskas and Jon Witman]** may not have officially 'placed' but their team t-shirts impressed competitors. Other members of EEB who participated in a relay team (***Huxley's Bulldogs***) included **Alan Bergland** and **Seeta Sistla.** Special thanks go to **Carol Casper** for team support and driving runners to and from relay points on race day!

MBL entered three teams: The Ecosystems P.I. team was **John Hobbie**, **Chris Neill**, **Chuck Hopkinson** and **Ken Foreman.** The RA/TA team, "Let's kick this puppy!" was: Rich McHorney, Allison Burce, Mac Lee, Christie Haupert, and Clara Funk. The student team, "Little Puppy," was: Cara Machacek, Jeff Walker, Craig McGowan, Will Longo and Adam Akullian.

New EEB Faculty Member

By Beth Brainerd

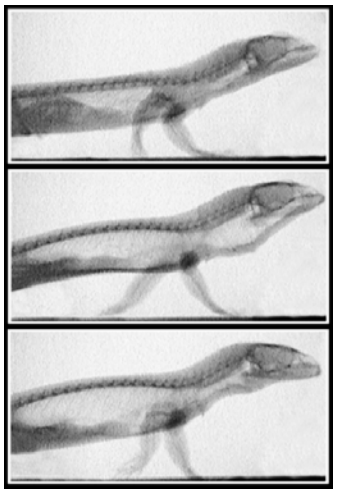
I joined the EEB faculty in July 2005 after ten years at UMass Amherst as an Assistant and then Associate Professor. EEB's outstanding research group in evolutionary morphology attracted me to Brown, along with the opportunity to teach human gross anatomy to medical students. I have always admired the depth of anatomical knowledge that comes from teaching human anatomy for many years, and my graduate students will also benefit from taking and teaching this course. In addition I am looking forward to teaching seminar classes for undergraduates and graduate students and providing research mentoring for students at all levels.

In joining the morphology group at Brown I am particularly excited by the vibrant graduate education environment that this large and active research group can offer. In support of graduate training the morphology group has established the Bushnell Graduate Research Fellowship to be awarded to our most outstanding graduate applicant each year. This fellowship is funded by a family foundation established in honor of my grandfather, and this foundation is also funding Bushnell Faculty Research Grants to support innovative research in the EEB morphology group.

In my research program I attempt to take the broadest possible perspective on vertebrate form, function, evolution and development. I am currently interested in new biomedical imaging technologies, such as high-resolution CT scanning, MRI, ultrasound and laser scanning confocal microscopy, that are opening up vast worlds of cross-sectional and three-dimensional anatomy. Studies of vertebrate functional morphology, biomechanics, paleontology and development are poised at the edge of a revolution in our ability to capture and quantify complex morphology and movement in 4D (3 spatial dimensions plus time), and to integrate our understandings of function, development and evolution.

The research facilities and opportunities for collaboration at Brown will make it possible for me to bring together the two main themes of my research to date: dynamic x-ray imaging (videofluoroscopy) and the 3D architecture of muscle-tendon systems. I have long been fascinated by the power of videofluoroscopy to reveal the hidden movements of internal structures, such as bones and lungs, of animals (see frames from an x-ray movie of a lizard running on a treadmill, reproduced below). At Brown I am working with Steve Gatesy and other colleagues to develop a 3D version of videofluoroscopy that will allow us to visualize and quantify skeletal movement in a wide range of animals. This technology combines high-resolution 3D models from CT scanning with biplanar videofluoroscopy to generate a data-rich visualization of skeletal movement that includes all of the shape information from the CT scan. We call this new combination of CT scanning and x-ray video "CTX imaging."

CTX will allow me to combine my interests in muscle-tendon architecture with my interest in videofluoroscopy. In our work on muscle architecture, my former doctoral student (Manny Azizi, who is now a postdoc with Tom Roberts at Brown) and I discovered that muscle bulging can have a strong effect on the speed and force of muscle shortening. It is a familiar fact that when muscles shorten they also bulge out. This bulging has generally been assumed to be an unimportant byproduct of muscle shortening, but our work has shown that muscle fiber angle and bulging can interact to increase the shortening speed of muscles. To test this hypothesis in various muscle-tendon systems we need to measure the 3D shape changes of muscles and overall muscle velocity. With CTX we can implant metal markers in soft tissues to measure shape change and we can map muscle attachments onto the visualizations of skeletal movement to quantify overall muscle shortening *in vivo*. Combining these techniques with ultrasound to measure changes in muscle fiber angles will give us a comprehensive understanding of muscle mechanics in whole animals during natural movements.



Seth Bordenstein

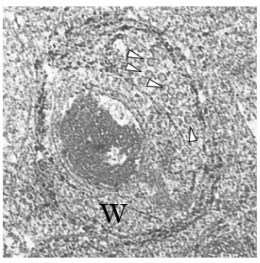
The Josephine Bay Paul Center, MBL

Our lab (Sarah Biber, Michelle Marshall, Seth Bordenstein) is broadly interested in microbial-host interactions that have relevance to basic biology and applied biomedicine at multiple disciplinary levels, i.e., genetic, ecological, evolutionary, and genomic. We focus on endosymbiotic associations, in which one organism lives and replicates within another organism. Without the establishment of such bacterial endosymbioses billions of years ago, life as we know it today would be unrecognizable. From the origin of the eukaryotic cell to the formation of entirely new ecosystems, ancient endosymbioses involving a bacterial partner initiated several major evolutionary and ecological transitions in the history of life. Today, younger systems of endosymbiotic bacteria are still formidable players in shaping life, spurring on the evolution of incipient organelles and posing threats to human health. Our research goals are to draw general conclusions about the genomic events that shape intracellular parasitism and mutualism, the impacts of mobile DNA in intracellular bacteria, the role of endosymbiotic bacteria in the origin of new species, and the evolution of host-microbe genome interactions. We broadly address three questions: How do the genomes of parasites and mutualists evolve in obligate intracellular bacteria? How important are genome interactions between intracellular microbes and eukaryotic hosts? Does endosymbiosis spawn new host species?

While our interests span bacteria in general, our study system over the past ten years is *Wolbachia* – a genus of alpha-Proteobacteria that groups phylogenetically with the bacterial ancestor of mitochondria and is the dominant obligate endosymbiotic bacteria on the planet, occurring in at least 20% of all insect species (such as the parasitoid wasp, *Nasonia vitripennis*), as well as other arthropods and filarial nematodes. The spread of *Wolbachia* throughout eukaryotes likely represents one of the great pandemics on the planet. These intracellular infections typically occur in the reproductive tissues of their insect and nematode hosts and are primarily transmitted vertically through the egg, but can also be horizontally transmitted between hosts. They affect key evolutionary processes in insects such as sex determination, sexual selection, and speciation – of which the latter has been a major focus of our research. *Wolbachia* that infect filarial nematodes are also causative agents of debilitating pathologies in humans, including lymphatic filariasis and river blindness.

The abundance of these bacteria and their broad effects on invertebrate biology and human health provide a plethora of replicated natural experiments involving infection and adaptation in varied hosts. Their parasitic effects on arthropod reproduction include a sperm-egg incompatibility, feminization, parthenogenesis, and male-killing, which are collectively denoted ‘reproductive parasitism’. Their beneficial effects in filarial nematodes include vital impacts on fertility and larval viability. We use this natural plasticity in phylogenetic analyses to determine the direction of evolution of intracellular parasitism and mutualism, i.e., which arose first during the radiation of this infection.

Our most active research projects are on mobile genetic elements in *Wolbachia* and other obligate intracellular bacteria. Recent studies conducted with Bay Paul Center colleague Jen Wernegreen indicate that a temperate bacteriophage is surprisingly common, laterally transfers between divergent strains, and recombines at high rates in the arthropod *Wolbachia* (photo shows phage particles inside *Wolbachia*); these findings indicate that phage are a significant source of genomic flux in this confined bacteria and raise future challenges on determining whether they promote genetic diversity. We are now undertaking structural, functional, and genomic studies of the bacteriophage. The information gained from these studies may lead to applications to transform *Wolbachia* or the development of biotherapy tools to control *Wolbachia*-assisted filarial diseases.



Education: Our lab directs a NASA/NSF-funded K-12 outreach workshop, Discover the Microbes Within! (http://jbpcweb.mbl.edu/microbial-workshop-2005.html) and we are looking forward to graduate education synergies under the joint program.

David J Patterson

The Josephine Bay Paul Center, MBL

If defined by his academic roots, David J. (Paddy) Patterson, one of our MBL associates, is a protozoologist. His enthusiasm for these things began in Belfast (Northern Ireland) when he was 14. The roots were nourished during undergraduate training at Queen's University Belfast in the days when you could still get a degree in Zoology. The traits continued to be cultivated while completing a Ph.D. at Bristol University (very like Brown). The process matured during the 14 years that he was a member of faculty at Bristol. Then he moved to the University of Sydney in Australia to run the School of Biological Sciences, and where he stayed for 10 years before his last move to the Marine Biological Laboratory. The nurturing process bore fruit in the form of about 140 scientific papers, and associations with various societies and journals.

During that time, Paddy's interests moved from physiology, through cell biology, to descriptive (alpha) taxonomy and to phylogeny (of protists). During this time, his most significant statement was articulating that major lines of protistan evolution can be defined by reference to the ultrastructural features that members of those lineages hold in common. In 1999, about 80 such lineages were defined (Patterson, 1999). These still remain robustly the building blocks for the eukaryotic tree of life. It is this interest and perspective on the evolution of protists that forms the basis of his working relationship with Mitch Sogin who was tackling the same problems with the emerging molecular tools at the Bay Paul Center at the Marine Biological Laboratory. That made the MBL the place to escape the growing frustrations of trying to make progress within a University environment.

Progress in science is intriguing. Popper's disparaging comments about *Amoeba* when comparing *Amoeba* to Einstein (Popper 1984) undermined his credibility in Paddy's eyes (he'd like to see Einstein undergo binary fission). Popper's idea that scientists make progress through falsification of hypotheses really didn't seem to hold water. Most scientists are conservative, don't move very far, and retain their models in the light of sometimes overwhelming contradictory evidence. Their choice of paths is determined more by who holds sway at funding agencies. Despite the myriad hypotheses raised in proposals, the number of scientific papers that cast falsified hypotheses off as milestones along the path of science (a Thomas Henry Huxley – great man – term) is miniscule. Progress in science is considerably less attributable to a process, and considerably more attributable to vision and passion.

Over his life in protozoan taxonomy, Paddy has described many new taxa. He and his team that he calls Protsville as a testament to Phil Spector's 'Wall of sound', have authored about 250 new taxa, with *Cafeteria* and *Massisteria* being some of the better ones, but probably the best are *Kiitoksia kaloista* and *Kiitoksia ystava* – which are Finnish for 'Thank you my old friend' and 'Thank you for the fish'. The taxonomic interests led to membership of the International Commission for Zoological Nomenclature, as well as a seat on the editorial committee that deals with the names of plants (algal section). During a sabbatical in 2000 with Mitch Sogin at the MBL, he met up with Dave Remsen. As a result, he began to see taxonomy much less as an exercise of making an inventory of the diversity of life, and more as a means of managing information about organisms. When stumped for information, the ultimate solution in Biology is to 'Ask an expert' – because experts are the informed custodians of much of our biological knowledge.

These days, Genbank continues to expand logarithmically, information about ecosystems streams in from unmanned scientific monitors or from satellites, and new technologies threaten us with over a million datum points about the diversity within a habitat generated from a single laboratory within a matter of hours. This expansion of information is fit to drown us and creates a seriously worrisome challenge to marshal this information. It is scary because if we fail to manage this information, our insights become increasingly fragmented and idiosyncratic, and science will increasingly develop a reputation for knowing everything about nothing. That, I suspect, could undermine our grand vision for why science (and we) are important. Through dialog with Dave Remsen, it became clear that informatics tools could be developed that emulate some of the generic elements of taxonomy to manage biological information. Every piece of 'biocentric' information out there has been labeled with the name of the organism. That makes names into metadata, and names can be used, as they are in the

index of a book, to tell you where (on which pages) you can find information about this organism. Names collectively form a 'controlled vocabulary' that can be used to index and organize information about organisms. If we wish to use names in this way, and if we wish to access all biological information about organisms, we will need to acquire all names of all organisms – not just the nomenclaturally proper names, but the typographical errors, archaic names, vernacular names, and so on. When the plan to do this just for the protists was met with the response 'That's not possible!' the red flag went up. Within 3 months, comprehensive coverage of protists was achieved and now, almost 4 years later our names repository NameBank (http://www.ubio.org) contains over 5,000,000 names from those of virus-like particles to the blue whales. At the time of writing a further 1,500,000 names are being processed. Once embedded within internet services, every name in this compilation can be used to find, index and organize biological information that is accessible through the internet – whether located superficially or deep in databases where even Google cannot go.

Another response to the problems of data management was to form major databases from federations of smaller databases (OBIS for the Census of Marine Life, or the GBIF environment in Copenhagen). Federated databases are flawed because the data on *Pomatomus saltator* are not combined with data under the name *Pomatomus saltatrix* even though the entries refer to the same organisms. Federation alone doesn't have a mechanism for dealing with alternative names for the same taxa other than to ask a large team of experts to work through all the records and 'normalize' the names. As 1% of the names change every year and there is a 1% expansion every year, this task of normalizing names is a bit like painting the Firth of Forth road bridge, once you get finished you have to start all over again. Other anomalies are that databases such as PubMed generate more 'hits' with a query for *Drosophila* than with the word 'Diptera' – whereas our expectations would be that a search on Diptera would find all articles on *Drosophila* and then maybe a few more because there are after all about 250,000 fly names out there (one of the uselessly stultifying pieces of information you pick up when compiling lots of names). To be effective, biological indexing services need to be based on more than names alone. We need to build mechanisms to 'reconcile' alternative names so that a query initiated with *Pomatomus saltator* will find data under that name and under the name *Pomatomus saltatrix* and under the name bluefish (etc. and so forth). Similarly, biologists love hierarchies, and they want to know not only about the biology of *Drosophila melanogaster*, but also about the other species in the genus, or indeed about all fruit flies or subsets thereof. To achieve this we need to build the names into classification schemes and exploit the hierarchy in various browsing strategies. But this introduces another problem, Paddy wouldn't be seen dead using a classification scheme authored by Tom Cavalier-Smith and the converse is probably equally true. So enhancing names-based indexing with biologically informed ontologies, such as mapping names into reconciliation groups and hierarchies, must allow for all points of view and opinions, no matter how insane or inane.

Once such a taxonomically informed names-based indexing environment is established within network services, it can be called upon in a myriad of ways. Paddy uses this structure as the organizational core for micro*scope (http://microscope.mbl.edu), the prototype of a generic biological knowledge management system. In these star*sites, a unified compilation of names (called CU*STAR) is used to index and organize information that is assembled locally, offers a means of browsing through data, and explores remote web-accessible data environments for more information on the same taxa. Tools can read documents and tell us which organisms are mentioned in them, and this can be exploited to auto-index the burgeoning mass of digitized literature. And it therefore follows that the same structure can be used as a cross project indexer, running reconciliation services on the fly, capable of organizing and indexing resources such as the teaching documents of a department to the research results from a funding agency such as the National Science Foundation.

The vision is that taxonomic indexing services have the capacity to manage the deluge of observations of the biological world. And the passion is that in so doing, we can better reveal the value of a reasoned and cumulative understanding of the natural world to a wider audience – and this will help erode the growth of pseudo-science that has the capacity to do so much damage to our futures.

Linda Amaral Zettler

The Josephine Bay Paul Center, MBL

My current research involves studies of microbial diversity and interactions in both marine and extreme aquatic environments. My interest in microbes began as an undergraduate majoring in Aquatic Biology at Brown and continued through work as a graduate student in Biological Oceanography in the MIT/WHOI (Woods Hole Oceanographic Institution) joint program. My microbial work in the extremely acidic, heavy metal rich Rio Tinto (literally "Red River") of southwestern Spain started in 1999 through an NIH postdoctoral fellowship and continues today in my laboratory as part of NASA's Astrobiology Institute. We are currently using Serial Analysis of Ribosomal Gene Sequence Tags (SARST) along with rRNA gene clone library methods to conduct microbial ecological diversity assessments of the three-domains of life (Bacteria, Archaea and Eukarya) in the Rio Tinto, considered a terrestrial analogue for Mars. The Rio Tinto is an interesting ecosystem in that while the sulfur cycle is important, the iron cycle seems to play the central role in both chemolithotrophy and maintenance of the extreme conditions in the river. Primary production is dominated by photosynthetic eukaryotes that form luxurious blooms in parts of the river and often dominate the microbial biomass. The ultimate goal of this research is to apply an ecogenomics approach to further explore microbial interactions and processes in this ecosystem. Mitchell Sogin and I are also participating in collaborative research and training in the Rio Tinto with Jim Head and Jack Mustard in the Department of Geological Sciences at Brown University with the goal of identifying appropriate biosignatures for use in remote sensing studies of Earth and Mars.

My second major research program is one of four projects funded through the NIEHS/NSF Woods Hole Center for Oceans and Human Health. Rebecca Gast (WHOI Biology) and I are collaborating on a field-based project of Mt. Hope Bay (in the NE corner of Narragansett Bay) that aims to explore the connections between thermal pollution, sewage outfall, physical oceanography, and endemic and introduced human pathogens in this estuarine system. We are also collaborating with Martin Polz (MIT) in searching for vibrios in Mt. Hope Bay. While some human pathogens are natural members of the marine microbial community (e.g. *Vibrio* species), many others, such as the protist *Giardia*, are introduced into seawater from sewage input and terrestrial runoff. Despite the potential for their impact on human health, little is known about the occurrence, much less the prevalence and distribution, of traditionally non-marine human pathogens. Studies that examine pathogen presence and persistence need to be coupled with predictive models in order to begin to determine where and when the risks of potential infection, or simply the presence of pathogens, are highest. We hope to combine observations of the physico-chemical environment with biological distribution and persistence information, to build and validate a three-dimensional water quality-eutrophication model for the bay that could be used to predict where and when pathogens could be found.

My lab recently hosted a secondary school teacher Bob Weinheimer from Danbury, CT to participate in our field and lab-based studies in Mt. Hope Bay for two weeks this past August. We hope to be able to incorporate the genetic and physical data that we collected during his visit into lesson plans and exercises that he prepares for his students. In addition to opportunities for teachers, there are also research opportunities for undergraduates in my lab as part of an REU supplement awarded last year to the Woods Hole Center for Oceans and Human Health. This program offers undergraduates a chance to work on a research project like the one in Mt. Hope Bay or any of the four major research projects funded through the Center that include harmful algal blooms, as well as human pathogens in the marine environment. The Center's most recent endeavor has been research on microbial pathogens in Lake Pontchartrain associated with floodwaters from Hurricane Katrina. This project (in collaboration with Rebecca Gast and Martin Polz) may represent the "worst case" scenario for contamination of coastal waters that can potentially be informative for all subsequent efforts concerning the assessment and understanding of Oceans and Human Health issues involving microbial populations and human pathogens.

Spring 2005 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

September 23 **Doug Morse,** Professor, Brown University. *Who lives in my study area? Some inhabitants of an old-field community*.

September 30 **Kristi Montooth,** Postdoctoral Research Associate, Brown University. *Evolving alcohol tolerance with a twist: interactions between membranes, biochemical flux and tolerance in* Drosophila.

October 7 **Ed Rastetter,** The Ecosystems Center, Marine Biological Laboratory. *Ecosystem modeling for non-programmers.*

October 14 **Liz DeMattia,** School for Field Studies. *Conservation and education at the School for Field Studies.*

October 21 **Keith Metzger,** Postdoctoral Research Associate, Brown University. *Feeding in vertebrates: profiles in functional novelty, tradeoffs, and neuromotor conservation.*

October 28 **Colin Meiklejohn,** Postdoctoral Research Associate, Brown University. *The genetics and evolution of gene expression.*

November 4 **Amity Wilczek,** Postdoctoral Research Associate, Brown University. *Parent-offspring conflict and genomic imprinting in plants.*

November 11 **Keryn Bromberg,** Graduate Student, Brown University. *The role of a foundation species in the response of a New England salt marsh to climate change.*

November 18 **Thomas Flatt,** Postdoctoral Research Associate, Brown University. *Costs of reproduction and the germline regulation of aging in* Drosophila.

December 2 **Robert Haney,** Graduate Student, Brown University. *Molecular population genetics in the wild: multi-locus approaches with an emphasis on the Percomorpha.*

December 9 **Heather Reed,** Postdoctoral Research Associate, Brown University. *Invasion of a C4 grass into a C4 grassland: a tale of two species.*

Monday Colloquia

September 12 **Melinda Smith,** Yale University. *Dominance, diversity and the functioning of ecosystems.*

September 19 **David Carrier,** University of Utah. *The running-fighting dichotomy and the evolution of aggression in hominids.*

September 26 **Bess Ward,** Princeton University. *Microbial diversity and ecosystem function: microbial nitrogen transformations in the marine environment.*

October 17 **Andrew Simons,** University of Minnesota. *Phylogeography and cryptic diversity of central highlands fishes.*

October 24 **Diane O'Brien,** Institute of Arctic Biology, University of Alaska. *Amino acid nutrition in insects-a stable isotope approach to understanding how diet influences reproductive strategy.*

October 31 **Adam Martiny,** Civil and Environmental Engineering, MIT. *Linking bacterial genomics and nutrient cycling in the ocean.*

November 7 **Blaire van Valkenburgh,** University of California-Los Angeles. *The rise and fall of North American canids.*

November 14 **Maureen Stanton,** University of California-Davis. *Cis- and trans- interactions in a multi-species ant-plant symbiosis.*

November 28 **Michael Ruse,** Florida State University. *Form and function in biology: rival paradigms?*

December 5 **Jeremy Jackson,** Scripps Institution of Oceanography, UCSD. *Brave new ocean.*

December 12 **George Gilchrist,** College of William & Mary. *Clines and climate: thermal selection in* Drosophila.

New Publications

Ballard, J.W.O. and D.M. Rand. 2005. *The population biology of mitochondrial DNA and its phylogenetic implications.* Annual Review of Ecology, Evolution and Systematics 36:621-642.

Brainerd, E.L. and E. Azizi. 2005. *Muscle fiber angle, segment bulging and architectural gear ratio in segmented musculature.* Journal of Experimental Biology 208:3249-3261.

Bruno, J.F., J.D. Fridley, K.D. Bromberg, and M.D. Bertness. 2005. *Insights into biotic interactions from studies of species invasions.* in Species Invasions: Insights into Ecology, Evolution, and Biogeography. Eds. Sax, D.F., J.J. Stachowicz and S.D. Gaines. Sinauer Associates, Inc., Sunderland, MA.

Crain, C.M. and M.D. Bertness. 2005. *Community impacts of a tussock-forming sedge: Is ecosystem engineering important in physically benign habitats?* Ecology 86:2695-2704.

Dukas, R. and D.H. Morse. 2005. *Crab spiders show mixed effects on flower visitation by bees and no effect on plant fitness.* Ecoscience 12:244-247.

Dukas, R., D.H. Morse and S. Myles. 2005. *Experience levels of individuals in natural bee populations and their ecological implications.* Canadian Journal of Zoology 83:492-497.

Field, D. and J.B. Hughes. 2005. *Cataloguing our current genome collection.* Microbiology 151:1016-1019.

Flatt, T., M.-P. Tu and M. Tatar. 2005. *Hormonal pleiotropy and the juvenile hormone regulation of* Drosophila *development and life history.* BioEssays 27:999-1010.

Flatt, T. 2005. *The evolutionary genetics of canalization.* Quarterly Review of Biology 80:287-316.

Gatesy, S.M. & D.B. **Baier,** 2005. *The origin of the avian flight stroke: a kinematic and kinetic perspective.* Paleobiology 31:382-399.

Gatesy, S.M., N.H. Shubin, & F.A. Jenkins, Jr. 2005. *Anaglyph stereo imaging of dinosaur track morphology and microtopography.* Palaeontologia Electronica 8:1;10A: http://palaeo-electronica.org/2005_1/gatesy10/issue1_05.htm

Grottoli, A.G., L.J. Rodrigues, K.A. Matthews, J.E. Palardy and O.T. Gibb. 2005. *Pre-treatment effects on coral skeletal $\delta^{13}C$ and $\delta^{18}O$.* Chemical Geology 221:225-242.

Heschel, M.S., N. Hausmann and J. Schmitt. 2005. *Testing for stress-dependent inbreeding depression in* Impatiens capensis *(Balsaminaceae).* American Journal of Botany 92:1322-1329

Hughes, J.B. and J.J. Hellmann. 2005. *The application of rarefaction techniques to molecular inventories of microbial diversity.* Methods in Enzymology 397:292-308.

Kraus, J.M. and D.H. Morse. 2005. *Seasonal habitat shift in an intertidal wolf spider: the role of photoperiodic and temperature cues.* Journal of Arachnology 33:110-123.

Mendoza, M., C. M. Janis and P. Palmqvist. 2005. *Ecological patterns in the trophic-size structure of large mammal communities: a taxon-free characterization. Evolutionary Ecology Research* 7:1-26.

Metzger, K.A. and A. Herrel. 2005. *Correlations between lizard cranial shape and diet: a quantitative, phylogenetically informed analysis.* Biological Journal of the Linnean Society. 86:433-466.

Morse, D.H. 2005. *Initial responses to substrates by naïve spiderlings: single and simultaneous choice.* Animal Behaviour 70:319-328.

Palardy, J.E., A.G. Grottoli, K.A. Matthews. 2005. *Effects of upwelling, depth, morphology and polyp size on feeding in three species of Panamanian corals.* Marine Ecology Progress Series 300:79-89

Rand, D.M. 2005. *Mitochondrial genetics of aging: intergenomic conflict resolutions.* Science of Aging Knowledge Environment 45:5-9 [DOI:10.1126/sageke.2005.45.re5].

Roberts, T.J. 2005. *A step forward for locomotor mechanics.* Journal of Experimental Biology 208:4191-4192.

Stinchcombe, J.R., A.L. Caicedo, R. Hopkins, C. Mays, E.W. Boyd, M.D. Purugganan and J. Schmitt. 2005. *Vernalization sensitivity in* Arabidopsis thaliana*: the effects of latitude and FLC variation.* American Journal of Botany 92:1701-1707.

Tatar, M. 2005. *SIR2 calls upon the ER.* Cell Metabolism. 2:281-282.

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